USER MANUAL UMAX090550
USER MANUAL UMAX090560
Version V2.0

12V or 24V BATTERY CHARGER

With SAEJ1939

USER MANUAL
P/N: AX090550
P/N: AX090560

In Europe:
Axiomatic Technologies Oy
Höytämöntie 6
33880 LEMPÄÄLÄ - Finland
Tel. +358 103 375 750
Fax. +358 3 3595 660
www.axiomatic.fi

In North America:
Axiomatic Technologies Corporation
5915 Wallace Street
Mississauga, ON Canada L4Z 1Z8
Tel. 1 905 602 9270
Fax. 1 905 602 9279
www.axiomatic.com

ACCRONYMS

ACK	Positive Acknowledgement	(from SAE J1939 standard)
CAN	Controller Area Network	
DM	Diagnostic Message	(from SAE J1939 standard)
DTC	Diagnostic Trouble Code	
EA	Electronic Assistant, p/n AX070502 (A Service Tool for Axiomatic ECUs)	
ECU	Electronic Control Unit	(from SAE J1939 standard)
FMI	Failure Mode Identifier	
NAK	Negative Acknowledgement	(from SAE J1939 standard)
PDU1	A format for messages that are to be sent to a destination address, either specific or global	(from SAE J1939 standard)
PDU2	A format used to send information that has been labeled using the Group Extension technique and does not contain a destination address.	
PGN	Parameter Group Number	(from SAE J1939 standard)
PropA	Message that uses the Proprietary A PGN for peer-to-peer communication	
PropB	Message that uses a Proprietary B PGN for broadcast communication	
PWM	Pulse Width Modulation	
OC	Occurrence Count	
SPN	Suspect Parameter Number	(from SAE J1939 standard)
VPS	Voltage Power Supply	

TABLE OF CONTENTS

1. INTRODUCTION

The battery charger is designed to autonomously charge automotive batteries. The AX090550 model can charge 12V batteries with a maximum charging current of 25A, and the AX090560 model can charge either 12 or 24V batteries with a maximum charging current of 15A.

AX090550	12VDC Battery Charger 25A
AX090560	12/24VDC Battery Charger 15A

Once programmed, the charger does not require any operator's involvement in the charging process; the charger automatically recognizes the presence of the battery, charges the battery to the maximum capacity, and automatically maintains the battery charge if the charger is connected to the power line. The AX090560 model will also automatically detect whether a 12 or 24V battery is used and adjust the charging profile to the battery connected accordingly.

When the charger is disconnected from the power line it automatically, by default, switches off in one minute, protecting the batteries from discharge.

There are three main charge modes – Precharge Mode, Bulk Charge Mode, and Constant Voltage Charge Mode – which along with Float Mode for maintaining charge, and a special Equalize Mode, allow automotive batteries to be charged safely and efficiently, prolonging their life. Temperature sensing using an auxiliary temperature sensor or through the J1939 network protects batteries from overheating, shutting down the charging process if the battery temperature exceeds a certain level.

It is possible to keep a load connected to the battery. Current, drawing by the load, should however be less than the maximum battery charging current. Other conditions are also applied.

Both models are able to be operated as a power supply instead of a battery charger. While in power supply operation, there are various user-defined control sources available.

An internal red-green LED indicator on the front panel of the charger is used to monitor the internal state of the charger.

If connected to the J1939 CAN network, the charger continuously transmits its internal state, charging current and the battery voltage. It can also use the J1939 network to acquire the battery temperature and to perform any user specific functions on demand. The battery charger also supports J1939 regular node functions, including address claiming, PGN responses, etc.

The RS232 interface of the charger allows the user to change the battery type, program battery charger setpoints, flash the new software, and watch an internal state of the charger using one of the standard terminal emulation software (Tera Term, Hyperterminal, etc.).

Other useful features of the charger include universal power line input 95-250 ACV 45-65 Hz with power factor correction, output reverse polarity protection, and digital inputs/outputs for user specific functions.

2. BATTERY CHARGER OPERATION

To use the unit as a battery charger, confirm that the Operation Mode setpoint in Common Control is set to Battery Charger Mode.

The battery charger implements a three-stage charging algorithm with an additional charge stage for maintenance.

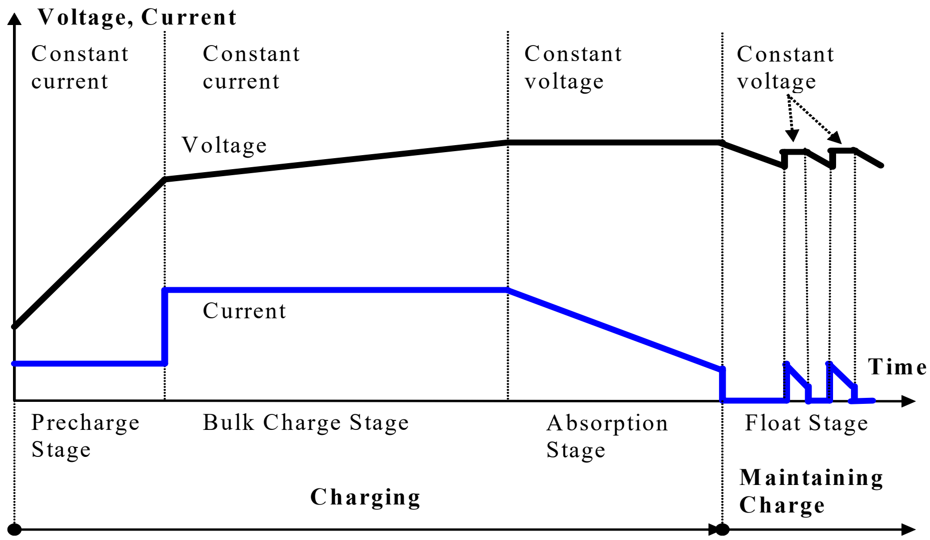


Figure 1. Battery Charger Algorithm Profile

The charging process starts from the Precharge Stage, then, when the battery voltage reaches a certain point, the charger switches to the Bulk Charge Stage, and the charging process is finalized in the Absorption (Constant Voltage Charge) Stage.

After the battery is fully charged, the charger maintains the battery charge in Float Mode.

2.1. Battery Charger Modes

Each stage of the charging process corresponds to one or two battery charger modes. There are also modes reflecting an idle or an error condition of the charger and a special charger supply mode used for testing.

The charger starts functioning from Idle Mode. It stays in Idle Mode until AC power is applied and a battery is connected to the charger.

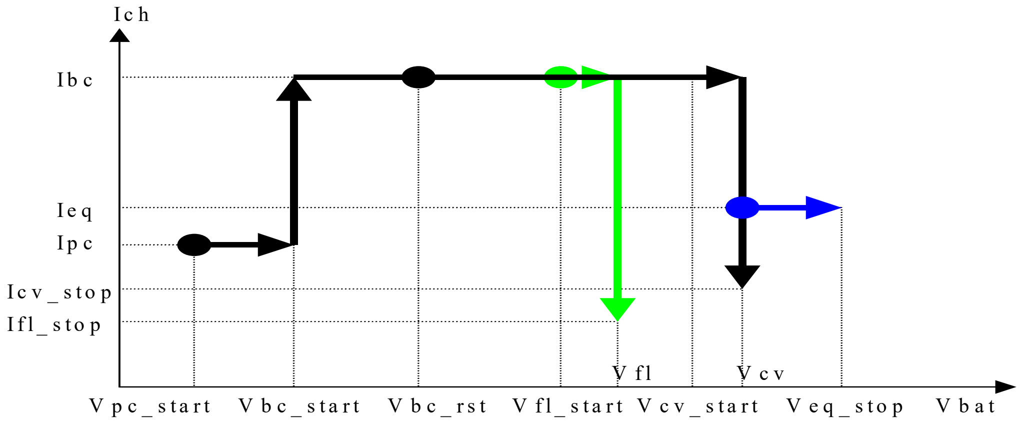


Figure 2. Voltage-Current Charging Profile

The AX090560 model will detect whether the battery connected is a 12 or 24V battery. When the charger recognizes the battery, it starts analyzing the battery state. If the battery is deeply discharged and its voltage is between Vpc_start and Vbc_start (Fig. 2.2), the charger will start the precharging process, charging the battery with a relatively small constant current Ipc. The small current prevents a deeply discharged battery from damage, which otherwise could occur due to gas emission from the battery electrolyte at high current. The charger will stay in the **Precharge Mode** until the battery voltage reaches the Vbc_start voltage or the maximum Precharge time Tpc_max has expired. In the latter case, the charging process will be interrupted, and the battery will go to **Battery Error Mode**.

When the battery reaches Vbc_start voltage, the charger will enter the **Bulk Charge Mode** increasing the charging current to Ibc. It will charge the battery with the Ibc current until the battery voltage reaches Vcv_start. At this point the battery is around 75% charged and the charger can go to the **Constant Voltage Charge Mode** limiting the charging voltage to Vcv. This will cause a gradual drop of the charging current. When the charging current drops to Icv_stop, the battery is considered fully charged, and the charger will stop the charging process and go to **Standby Mode**.

For flooded lead-acid batteries it is recommended that the charging process be complimented periodically with the equalization (every 3, 6, or 12 months, or when the specific gravity of the battery acid drops below a certain level, see the battery manufacturer's recommendations). In this case, immediately after the charging current drops to Icv_stop, instead of switching to Standby Mode, the charger will first go to **Equalize Mode** overcharging the battery with a constant current Ieq until the battery voltage reaches Veq_stop or the equalize time-out Teq_max is expired.

Equalize Mode is activated manually by setting a special setpoint. The setpoint value will be automatically reset after the charger enters Equalize Mode preventing the charger from running the equalization process more than one time.

In Standby Mode the charger only monitors the battery voltage. It will maintain the battery charge either by periodically recharging the battery when the battery voltage drops below Vbc_restart, or by maintaining the charge in **Float Mode**, if the voltage drops below Vfl_start voltage and Float Mode is enabled.

In Float Mode the charger limits the charging voltage to Vfl and the charging current Ibc. When the charging current drops below Ifl_stop, the charger returns to Standby Mode, keeping the battery voltage at a predefined level.

The charger will switch to Battery Error Mode in case the charging process fails or when the battery temperature exceeds a certain level. It will stay in this mode until the temperature returns to normal and then, after a minute delay, will go to Idle Mode to repeat the charging cycle. The battery charger will also switch to Idle Mode if the battery or power is disconnected.

In case of electronics failure, the charger will be locked in **Module Error Mode** until either the battery or the power is disconnected, and the charger goes to the initial Idle Mode.

2.2. Battery Charger State Diagram

A complete set of the charger modes and their relations to each other are shown on the Battery Charger State Diagram (Fig. 2.3).

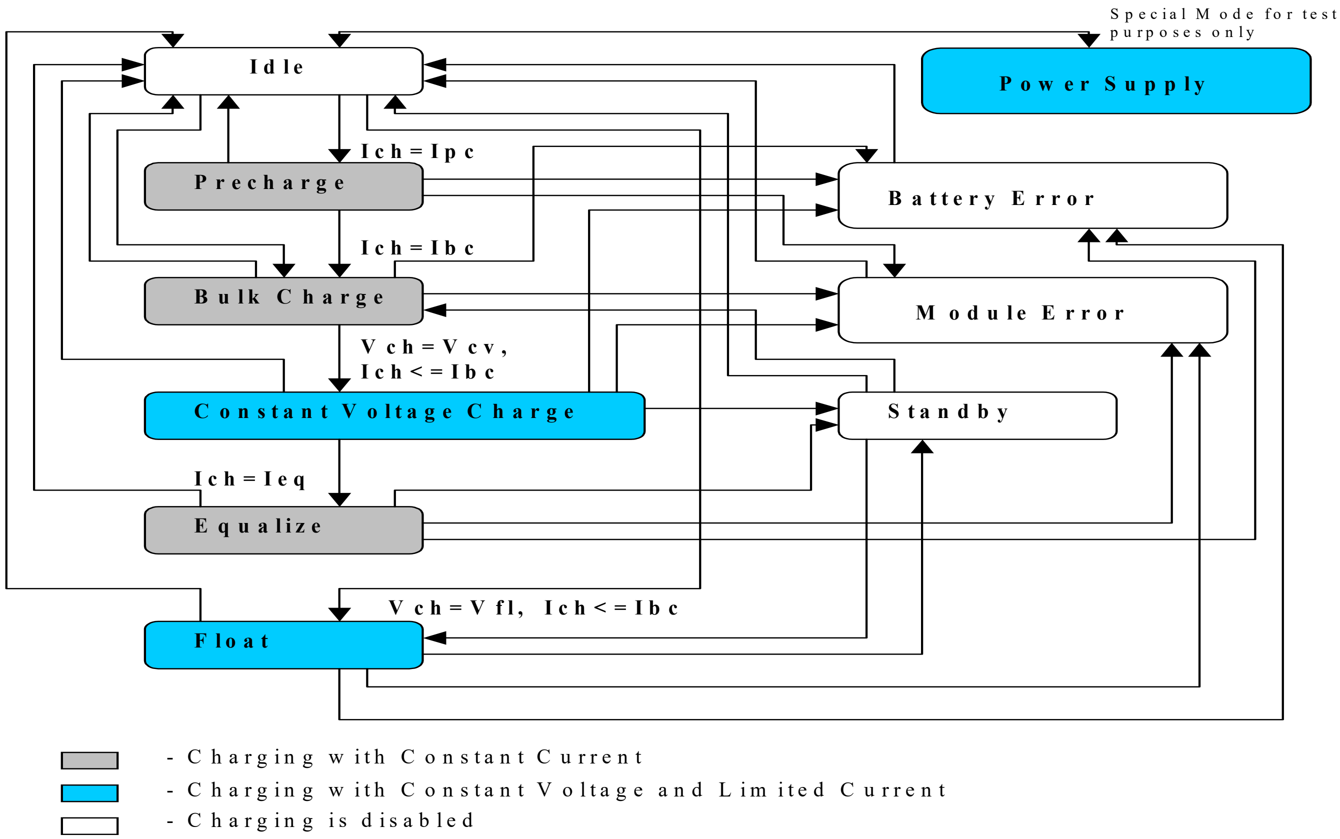


Figure 3. Battery Charger State Diagram

In order to avoid accidental switching of the charger from one mode to another due to noise, transients, etc., the condition causing the transition should stay on for at least 3 seconds.

A special, separate, password protected, Power Supply Mode is added for testing purposes only and is not intended to be used for charging batteries.

2.3. Battery Protection

To prevent a battery from damage, the battery charger has the following time-out setpoints: Tch limiting the hole charging process (which includes: Precharge, Bulk Charge and Constant Voltage Charge Modes), Teq for the Equalization Mode, and Tpc – a separate time-out for Precharge Mode.

Also, for safety, the charger monitors the battery temperature by an optional NTC thermistor or through the J1939 network and stops the charging process if the battery temperature increases higher than a certain level (the thermistor resistance drops below NTCRes_min).

2.4. Charging Batteries Connected to a Load

A load can be connected to the battery if the Float Mode is enabled and the battery is fully charged, e.g. the battery is in the Standby or Float Mode. The load current, however, should not exceed the charger Ibc current.

Connecting the load during the charging process when the charger is in the Precharge, Bulk Charge, or Equalize Modes, should be normally avoided because of distortion to the charging process that the load can cause. If, however, the presence of the load is required, the user should readjust the battery setpoints the way the charging process can be finalized in the presence of the load.

Please, keep in mind that cycling power in the Standby or Float Mode will start a new charging cycle, which, to be finalized, will require the new readjusted setpoints.

If the charging process fails, the battery charger will automatically redo the charging cycle after a minute delay.

3. POWER SUPPLY OPERATION

To use the unit as a power supply, confirm that the Operation Mode setpoint in Common Control is set to Power Supply Mode.

While used as a Power Supply, the unit can be controlled by up to three sources: **Power Supply Control Source**, **Power Supply Enable Source**, and **Power Supply Override Source**. Each source parameter has a corresponding **Number** parameter which is used to select the appropriate Source. All available sources are listed in the table below.

Value	Source Name	Source Number Range	Description
0	Control Not Used	0	
1	CAN Receive	1 - 4	See more details in Section 6.9
2	Constant Discrete Data	1 - 4	See more details in Section 6.7
3	Constant Continuous Data	1 - 4	See more details in Section 6.7

Table 1 – LED Indicator Modes

When an Override Source is selected and is in control of the output, the **Power Supply Override Value** parameter controls the value that the output voltage will be.

When the Control Source is in control of the output, the **Power Supply Minimum Output Voltage** and **Power Supply Maximum Output Voltage** parameters provide the upper and lower limit for the output voltage. If the Control Source is a CAN Receive input, the voltage is calculated as a percentage of the input value out of the range from the Data Min and Max of the CAN Receive, and applied to the Minimum and Maximum Output Voltage parameters. If the Control Source is a Constant Data input, the value is used if it falls inside of the Output Voltage range. These parameters, along with the **Power Supply Overcurrent** parameter have different ranges that they may be given the unit model, as seen in the table below.

Unit Model	Minimum Output Voltage	Maximum Output Voltage	Overcurrent Maximum Current
AX090550	5 V	12 V	25 A
AX090560	5 V	24 V	15 A

Table 2 – Power Supply Limit Differences Between Models

The behaviour of the unit when an overcurrent is detected is determined by the **Power Supply Overcurrent Setting** parameter. The unit can be configured such that an overcurrent is ignored, triggers a DM1 message, or causes the unit to shut down.

4. LED INDICATOR

A red-green internal state LED indicator is mounted on the battery charger front panel. Depending on the operation mode of the unit, the LED pattern represents different internal states.

Indicator Mode	Battery Charge Mode	Power Supply Mode
None	The charger is off.	No power is being supplied; there is nothing controlling the Power Supply.
Green Constant	The battery is charging. The charger is in the Precharge, Bulk Charge, Constant Voltage Charge, or Equalize Mode.	The Power Supply is being controlled by the Control Source.
Green Blinking (1 s)	The battery is fully charged. Charge maintenance may be performed. The charger is in Standby or Float Mode.	The Power Supply is being controlled by the Override Source. This supersedes the Control Source.
Red Constant	The charger is idling. Unable to start the charging process due to low power, absence of the battery or high battery temperature.	The power has been shutoff due to Overcurrent.
Red Blinking (1 s)	Battery Error. The charger is in the Battery Error Mode.	An overcurrent has been detected, but due to the Overcurrent setting the Power Supply keeps running.
Red Blinking at high rate (0.1 s)	Module Error. The charger is in the Module Error Mode.	N / A
Red - Green Blinking (1 s)	The charger is in the Charger Supply Mode.	The Power Supply has been disabled by the Enable Source. This supersedes the Override and Control Sources.

Table 3 – LED Indicator Modes

5. OVERVIEW OF J1939 FEATURES

The software was designed to provide flexibility to the user with respect to messages sent to and from the ECU by providing:

- Configurable ECU Instance in the NAME (to allow multiple ECUs on the same network)
- Configurable Transmit PGN and SPN Parameters

5.1. Introduction to Supported Messages

The ECU is compliant with the standard SAE J1939, and supports the following PGNs

From J1939-21 - Data Link Layer

- Request 59904 ($00EA00)
- Acknowledgment 59392 ($00E800)
- Transport Protocol – Connection Management 60416 ($00EC00)
- Transport Protocol – Data Transfer Message 60160 ($00EB00)

Note: Any Proprietary B PGN in the range 65280 to 65535 ($00FF00 to $00FFFF) can be selected

From J1939-73 – Diagnostics

- DM1 – Active Diagnostic Trouble Codes 65226 ($00FECA)
- DM2 – Previously Active Diagnostic Trouble Codes 65227 ($00FECB)
- DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs 65228 ($00FECC)
- DM11 – Diagnostic Data Clear/Reset for Active DTCs 65235 ($00FED3)

From J1939-81 - Network Management

- Address Claimed/Cannot Claim 60928 ($00EE00)
- Commanded Address 65240 ($00FED8)

From J1939-71 – Vehicle Application Layer

- Software Identification 65242 ($00FEDA)

None of the application layer PGNs are supported as part of the default configurations, but they can be selected as desired for either transmit or received function blocks.
Setpoints are accessed using standard Memory Access Protocol (MAP) with proprietary addresses. The Electronic Assistant® (EA) allows for quick and easy configuration of the unit over the CAN network.

5.2. Name, Address and Software ID

5.2.1. J1939 Name

The battery charger ECU has the following defaults for the J1939 NAME. The user should refer to the SAE J1939/81 standard for more information on these parameters and their ranges.

Arbitrary Address Capable	Yes
Industry Group	0, Global

Vehicle System Instance	0
Vehicle System	0, Non-specific system
Function	132, Axiomatic IO Controller
Function Instance	9, Axiomatic AX090550, Battery Charger
ECU Instance	**0, First Instance**
Manufacture Code	162, Axiomatic Technologies Corporation
Identity Number	Variable, uniquely assigned during factory programming for each ECU

The ECU Instance is a configurable setpoint associated with the NAME. Changing this value will allow multiple ECUs of this type to be distinguishable by other ECUs (including the Electronic Assistant) when they are all connected on the same network.

5.2.2. ECU Address

The default value of this setpoint is 128 (0x80), which is the preferred starting address for self-configurable ECUs as set by the SAE in J1939 tables B3 to B7. The EA will allow the selection of any address between 0 to 253, and ***it is the user's responsibility to select an address that complies with the standard***. The user must also be aware that since the unit is arbitrary address capable, if another ECU with a higher priority NAME contends for the selected address, the battery charger will continue select the next highest address until it finds one that it can claim. See J1939/81 for more details about address claiming.

5.2.3. Software Identifier

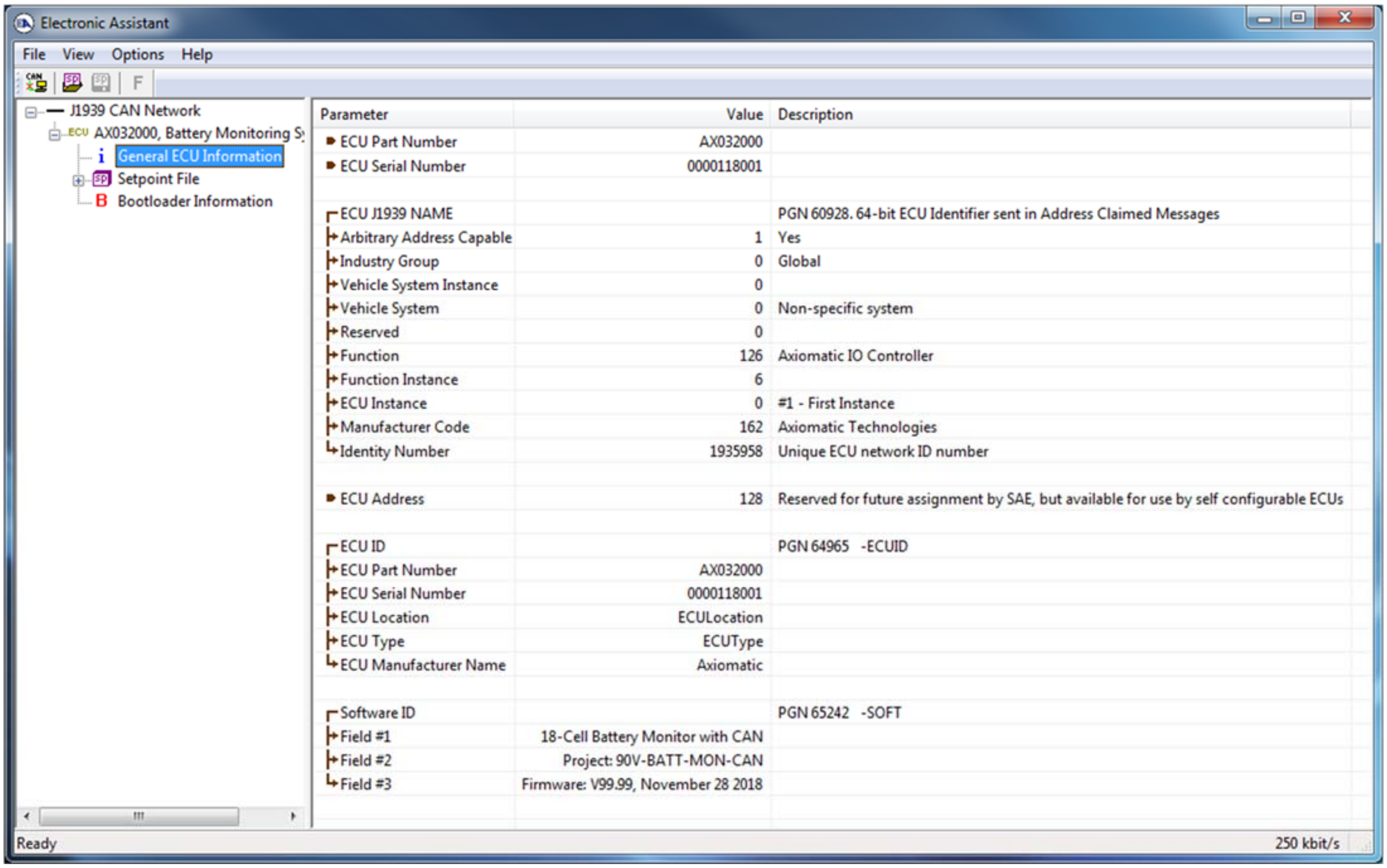
PGN 65242 Software Identification - SOFT
Transmission Repetition Rate: On request
Data Length: Variable
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 218 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65242 (0xFEDA)

Start Position	Length	Parameter Name	SPN
1	1 Byte	Number of software identification fields	965
2-n	Variable	Software identification(s), Delimiter (ASCII "*")	234

For the battery charger ECU, Byte 1 is set to 5, and the identification fields are as follows

(Part Number)*(Version)*(Date)*(Owner)*(Description)

EA shows all this information in “General ECU Information”, as shown below



Parameter	Value	Description
ECU Part Number	AX032000	
ECU Serial Number	0000118001	
ECU J1939 NAME		PGN 60928. 64-bit ECU Identifier sent in Address Claimed Messages
Arbitrary Address Capable	1	Yes
Industry Group	0	Global
Vehicle System Instance	0	
Vehicle System	0	Non-specific system
Reserved	0	
Function	126	Axiomatic IO Controller
Function Instance	6	
ECU Instance	0	#1 - First Instance
Manufacturer Code	162	Axiomatic Technologies
Identity Number	1935958	Unique ECU network ID number
ECU Address	128	Reserved for future assignment by SAE, but available for use by self configurable ECUs
ECU ID		PGN 64965 -ECUID
ECU Part Number	AX032000	
ECU Serial Number	0000118001	
ECU Location	ECULocation	
ECU Type	ECUType	
ECU Manufacturer Name	Axiomatic	
Software ID		PGN 65242 -SOFT
Field #1	18-Cell Battery Monitor with CAN	
Field #2	Project: 90V-BATT-MON-CAN	
Field #3	Firmware: V99.99, November 28 2018	

Note: The information provided in the Software ID is available for any J1939 service tool which supports the PGN -SOFT.

6. FUNCTION BLOCKS

6.1. Common Control Function Block

The Common Control function block is used to define parameters for the overall operation of the unit and for the control of the charging profile.

The first set of parameters deal with unit's operation in Power Supply Mode, please refer to Section 3 where these parameters are described in detail.

The **Output Voltage Limit**, setpoint is used to prevent the charger from entering Equalize Mode when the output voltage of the charger rises above the maximum voltage generated by the charger, Vcv. Limiting the output voltage to Vcv is necessary when there is a load connected to the battery and the load is not able to tolerate an overvoltage condition associated with Equalize Mode.

The **Activate Equalize Mode**, setpoint is used to schedule an equalization cycle for the battery. Once the equalization is done, the setpoint is automatically reset to 0 (No). This setpoint cannot be activated if the Output Voltage Limit setpoint is set. The **Power-Off Enable**, setpoint activates the battery charger shut-off in a minute, if the power line is disconnected from the charger, preventing the battery from being discharged by the battery charger electronics.

6.2. Charging Profile Function Block

The Charging Profile function block is used to set all parameters needed in the battery charging algorithm. These parameters characterize the conditions which the charging algorithm will use to switch between charging modes.

Please refer to Section 2, where these parameters are described in detail.

6.3. Display Board Function Block

The Display Board is offered as an add-on to the Battery Charger, and contains a push button digital input, and a 6-digit digital display. Depending on if there is a Display Board connected, the **Display Board Present** setting can be set to False to disable Display Board functions or set to True to enable them.

The push button digital input can be used in different ways depending on the **Push Button Setting** selected.

Value	Push Button Setting	Description
0	Control Not Used	The push button input is not used.
1	Used as Relay Source Only	The push button input is used only as a control source for relay outputs.
2	Toggle Display	The push button input is used to toggle which output data is used with the digital display. It

		may also be used as a control source for relay outputs.

Table 4 – Push Button Settings

The digital output display will show either the Battery Voltage (in Volts), or the Charger Output Current (in Amps). One of the two can be set as the **Default Output** for the data being displayed. If the Push Button Setting is set to Toggle Display, the data displayed will switch between the Battery Voltage and the Charger Output Current when the Push Button is pressed.

Value	Display Output	Description
0	Battery Voltage	The default value displayed on the Display Board is the Battery Voltage; units are in Volts.
1	Charger Output Current	The default value displayed on the Display Board is the Charger Output Current; units are in Amps.

Table 5 – Default Display Outputs

6.4. Relay Output Function Block

The Battery Charger has 4 configurable Relay Outputs, with each relay having 2 states: Normally Open, and Normally Closed. To reach these states, each relay has 3 pins: Normally Open (NO), Normally Closed (NC), and Common (COM). The following **Output Types** determine the configuration of the relay pins.

Value	Output Type
0	Output Not Implemented
1	Normal Logic
2	Inverse Logic
3	Toggle Logic
4	Latched Logic
5	Inverse Latched Logic

Table 6 – Relay Output Types

When the relay output is not implemented, the COM pin connects to NO, and will not change no matter the behavior of the source. A Normal Logic response connects COM to NC when the source is on, and COM to NO when the source is off. An Inverse Logic response connects COM to NO when the source is on, and COM to NC when the source is off.

For a Toggle Logic response, the COM pin switches between NO and NC at a rate determined by the configurable **Toggle Frequency** (in milliseconds) when the source is on, and COM remains connected to NO when the source is off.

For a Latched Logic response, the COM pin switches between NO and NC every time the source changes from off to on.

For an Inverse Latched response, the COM pin switches between NO and NC every time the source changes from on to off.

The logic which drives each relay output can be determined by the **Control Source**, **Unlatch Source**, **Enable Source**, and **Override Source**. These parameters can be chosen from the following list of sources.

Value	Relay Source	Description
0	Control Not Used	No source selected; this relay feature will be disabled.
1	Battery Charger State	This source is on when the control board is connected to the battery, and off when the battery is disconnected.
2	Power Line State	This source is on when the control board is connected to AC power via the charger, and off when the AC power connection is disconnected.
3	Temperature State	This source is on when either the charger or the battery temperature is above the normal limit set by the configurable thermistor value.
4	Push Button Input	This source is on when the push button is pressed, and off when the button is not pressed or there is no display board present.
5	Idle Mode On	This source is on when the charging algorithm is in Idle Mode, and off in any other mode.
6	Precharge Mode On	This source is on when the charging algorithm is in Precharge Mode, and off in any other mode.
7	Bulk Charge Mode On	This source is on when the charging algorithm is in Bulk Charge Mode, and off in any other mode.
8	Constant Voltage Charge Mode On	This source is on when the charging algorithm is in Constant Voltage Charge Mode, and off in any other mode.
9	Equalize Mode On	This source is on when the charging algorithm is in Equalize Mode, and off in any other mode.
10	Float Mode On	This source is on when the charging algorithm is in Float Mode, and off in any other mode.
11	Standby Mode On	This source is on when the charging algorithm is in Standby Mode, and off in any other mode.
12	Battery Error Mode On	This source is on when the charging algorithm is in Battery Error Mode, and off in any other mode.
13	Module Error Mode On	This source is on when the charging algorithm is in Module Error Mode, and off in any other mode.
14	Power Supply Mode On	This source is on when the charging algorithm is in Power Supply Mode, and off in any other mode.

Table 7 – Relay Output Control Sources

The Enable Source determines if the relay output will be commanded by the Control Source. If there is no Enable Source selected, the Control Source is automatically enabled. Otherwise the **Enable Response** selected changes how the **Enable Source** is used.

Value	Enable Response
0	Enable When ON
1	Enable When OFF
2	Disable When ON
3	Disable When OFF
4	Enable When ON Else Keep State
5	Enable When Off Else Keep State

Table 8 – Relay Output Enable Responses

If the **Enable Response Delay** is set to On, the relay output enable response gets delayed based on the amount of time set by the **Turn ON Delay** and **Turn OFF Delay** parameters.

Any response determined by the above parameters can be overwritten based on the Override Source and the **Override Response**. The output of the overwritten response will be the **Override State** parameter.

Value	Override Response
0	Override When On
1	Override When Off

Table 9 – Relay Output Override Responses

6.5. Network Function Block

The Network function block controls the way the battery charger communicates on the J1939 network. Further details on the J1939 network features are available in Section 5.

The Module Address (**ECU Address** in EA), setpoint specifies the dynamic network address of the battery charger, which is claimed when the charger is connected to the network. This setpoint can be changed automatically in case the address is already taken by a higher priority in the ECU.

The ECU Instance (**ECU Instance Number** in the EA), setpoint should be set by the user if two or more battery chargers are present on the network.

The **Transmit Charger PGN**, setpoint specifies whether the charger PGN specified by the Charger PGN, ChPGN, setpoint should be transmitted.

If the **Transmit Charger Diagnostics**, setpoint is set and the charger fails, the DM1 messages are sent with the SPN specified by the Charger Failure SPN, ChFailureSPN, setpoint.

The **Maximum Battery Temperature** and the **Name of the Battery**, setpoints define the battery temperature parameters the charger collects from the J1939 network in addition to the direct measurements of the battery temperature sensor.

6.6. Diagnostic Input Function Blocks

The Diagnostic Input function blocks are used to setup the diagnostic messages for the controller.

The 5 types of diagnostics supported by the battery charger are shown in Table 3.

Function Block	Minimum Threshold	Maximum Threshold
VPS Undervoltage Fault	VPS Undervoltage	N/A
VPS Overvoltage Fault	N/A	VPS Overvoltage
Over Temperature Fault	N/A	Temperature Shutdown
Lost Communication Fault	N/A	Received Message Timeout (any)

Table 10 – Fault Detection Thresholds

If and only if the **Event Generates a DTC in DM1** parameter is set to true will the other setpoints in the function block be enabled. They are all related to the data that is sent to the J1939 network as part of the DM1 message, Active Diagnostic Trouble Codes.

A Diagnostic Trouble Code (DTC) is defined by the J1939 standard as a 4-byte value which is a combination of:

SPN	Suspect Parameter Number	(first 19 bits of the DTC, LSB first)
FMI	Failure Mode Identifier	(next 5 bits of the DTC)
CM	Conversion Method	(1 bit, always set to 0)
OC	Occurrence Count	(7 bits, number of times the fault has happened)

In addition to supporting the DM1 message, the battery charger Controller also supports

DM2	Previously Active Diagnostic Trouble Codes	**Sent only on request**
DM3	Diagnostic Data Clear/Reset of Previously Active DTCs	**Done only on request**
DM11	Diagnostic Data Clear/Reset for Active DTCs	**Done only on request**

So long as even one Diagnostic function block has **Event Generates a DTC in DM1** set to true, the battery charger Controller will send the DM1 message every one second, regardless of whether there are any active faults, as recommended by the standard. While there are no active DTCs, the battery charger will send the “No Active Faults” message. If a previously active DTC becomes inactive, a DM1 will be sent immediately to reflect this. As soon as the last active DTC goes inactive, it will send a DM1 indicating that there are no more active DTCs.

If there is more than on active DTC at any given time, the regular DM1 message will be sent using a multipacket Broadcast Announce Message (BAM). If the controller receives a request for a DM1 while this is true, it will send the multipacket message to the Requester Address using the Transport Protocol (TP).

> At power up, the DM1 message will not be broadcast until after a 5 second delay. This is done to prevent any power up or initialization conditions from being flagged as an active error on the network.

The Diagnostic function block has a setpoint **Event Cleared Only by DM11**. By default, this is set to false, which means that as soon as the condition that caused an error flag to be set goes away, the DTC is automatically made Previously Active, and is no longer included in the DM1 message. However, when this setpoint is set to true, even if the flag is cleared, the DTC will not be made inactive, so it will continue to be sent on the DM1 message. Only when a DM11 has been requested will the DTC go inactive. This feature may be useful in a system where a critical fault needs to be clearly identified as having happened, even if the conditions that caused it went away.

In addition to all the active DTCs, another part of the DM1 message is the first byte, which reflects the Lamp Status. Each Diagnostic function block has the setpoint **Lamp Set by Event in DM1** which determines which lamp will be set in this byte while the DTC is active. The J1939 standard defines the lamps as '*Malfunction*', '*Red Stop*', '*Amber, Warning*' or '*Protect*'. By default, the *'Amber, Warning'* lamp is typically the one set by any active fault.

By default, every Diagnostic function block has associated with it a proprietary SPN. However, this setpoint **SPN for Event used in DTC** is fully configurable by the user should they wish it to reflect a standard SPN define in J1939-71 instead. If the SPN is change, the OC of the associate error log is automatically reset to zero.

Every Diagnostic function block also has associated with it a default FMI. The only setpoint for the user to change the FMI is **FMI for Event used in DTC**, even though some Diagnostic function blocks can have both high and low errors. In those cases, the FMI in the setpoint reflects that of the low-end condition, and the FMI used by the high fault will be determined per Table 4. If the FMI is changed, the OC of the associate error log is automatically reset to zero.

FMI for Event used in DTC – Low Fault	Corresponding FMI used in DTC – High Fault
FMI=1, Data Valid But Below Normal Operational Range – Most Severe Level	FMI=0, Data Valid But Above Normal Operational Range – Most Severe Level
FMI=4, Voltage Below Normal, Or Shorted To Low Source	FMI=3, Voltage Above Normal, Or Shorted To High Source
FMI=5, Current Below Normal Or Open Circuit	FMI=6, Current Above Normal Or Grounded Circuit
FMI=17, Data Valid But Below Normal Operating Range – Least Severe Level	FMI=15, Data Valid But Above Normal Operating Range – Least Severe Level
FMI=18, Data Valid But Below Normal Operating Range – Moderately Severe Level	FMI=16, Data Valid But Above Normal Operating Range – Moderately Severe Level
FMI=21, Data Drifted Low	FMI=20, Data Drifted High

Table 11 – Low Fault FMI versus High Fault FMI

If the FMI used is anything other than one of those in Table 4, then both the low and the high faults will be assigned the same FMI. This condition should be avoided, as the log will still use different OC for the two types of faults, even though they will be reported the same in the DTC. It is the user's responsibility to make sure this does not happen.

When the fault is linked to a DTC, a non-volatile log of the occurrence count (OC) is kept. As soon as the controller detects a new (previously inactive) fault, it will start decrementing the **Delay Before Sending DM1** timer for the Diagnostic function block. If the fault has remained present during the delay time, then the controller will set the DTC to active, and it will increment the OC in the log. A DM1 will immediately be generated that includes the new DTC. The timer is provided so that intermittent faults do not overwhelm the network as the fault comes and goes, since a DM1 message would be sent every time the fault shows up or goes away.

6.7. Constant Data Function Block

The Constant data function block is used to define constant data that can be used as control sources for the unit when in Power Supply Mode.

There are Discrete and Continuous setpoints,

6.8. CAN Transmit Function Block

The CAN Transmit function block is used to send data from the battery charger to the J1939 network.

Normally, to disable a transmit message, the **Transmit Repetition Rate** is set to zero. However, should the message share its Parameter Group Number (PGN) with another message, this is not necessarily true. In the case where multiple messages share the same **Transmit PGN**, the repetition rate selected in the message with the LOWEST number will be used for ALL the messages that use that PGN.

By default, all messages are sent on Proprietary B PGNs as broadcast messages. If all the data is not necessary, disable the entire message by setting the lowest channel using that PGN to zero. If some of the data is not necessary, simply change the PGN of the superfluous channel(s) to an unused value in the Proprietary B range.

Since the defaults are PropB messages, the **Transmit Message Priority** is always initialized to 6 (low priority) and the **Destination Address (for PDU1)** setpoint is not used. This setpoint is only valid when a PDU1 PGN has been select, and it can be set either to the Global Address (0xFF) for broadcasts or sent to a specific address as setup by the user.

Enabling the **Override Source Address**, allows the **Source Address** of the J1939 Identifier to be changed to any value between 0…255.

The **Transmit Data Size**, **Transmit Data Index in Array (LSB)**, **Transmit Bit Index in Byte (LSB)**, **Transmit Resolution** and **Transmit Offset** can all be used to map the data to any SPN supported message by the J1939 standard from any **Data Source** of the Transmit function block. Table 5 exhibits the possible **Data Sources** for use in CAN Transmits.

Value	Control Source
0	No Control Source
1	Battery Charger State
2	Power Line State
3	Battery State
4	Temperature State
5	Output Voltage
6	Output Current

7	Feedback Voltage
8	Feedback Current
9	Push Button Input

Table 12 – CAN Transmit Data Sources

The battery charger supports up to 10 unique CAN Transmit Messages, all of which can be programmed to send any available data to the CAN network. Each CAN Transmit Message is setup to send data from 4 configurable sources, and if each of the 4 sources is used, each source can have a size as large as 2-Bytes. Only the first 6 CAN Transmit Messages are configured by default, with the remaining 4 set to unused; the default list is shown in Table 6 below.

CAN Transmit #	Default Transmit Data	Byte Position	Bit Position	PGN
1	Battery Charger State	1st	1st	0xFF00
2	Power Line State	1st	5th	0xFF00
3	Output Voltage	2nd	1st	0xFF01
4	Output Current	4th	1st	0xFF02

Table 13 – Default CAN Transmit Messages

6.9. CAN Receive Function Block

The CAN Receive function block is designed to take any SPN from the J1939 network and use it as a control/enable/override source for any relay outputs or CAN Transmits.

The **Receive Message Enabled** is the most important setpoint associated with this function block and it should be selected first. Changing it will result in other setpoints being enabled/disabled as appropriate. By default, all receive messages are enabled.

Once a message has been enabled, a Lost Communication fault will be flagged if that message is not received within the **Receive Message Timeout** period. This will trigger a Lost Communication event if the cell input associated with the CAN Receive message is set to User Controlled under Rx Timeout Setting. In order to avoid timeouts on a heavily saturated network, it is recommended to set the period at least three times longer than the expected update rate. To disable the timeout feature, simply set this value to zero, in which case the received message will never timeout and will never trigger a Lost Communication fault.

By default, all control messages are expected to be sent to the battery charger on Proprietary B PGNs. However, should a PDU1 message be selected, the battery charger can be setup to receive it from any ECY by setting the **Specific Address that sends the PGN** to the Global Address (0xFF). If a specific address is selected instead, then any other ECU data on the PGN will be ignored.

The **Receive Data Size**, **Receive Data Index in Array (LSB)**, **Receive Bit Index in Byte (LSB)**, **Receive Resolution** and **Receive Offset** can all be used to map any SPN supported by the J1939 standard to the output data of the Received function block.

As mentioned earlier, a CAN receive function block can be selected as the source of the control input for the output function blocks. When this is the case the **Receive Data Minimum** (Off Threshold) and **Receive Data Maximum** (On Threshold) setpoints determine the minimum and maximum values of the control signal. As the names imply, they are also used as the On/Off thresholds for digital output types. These values are in whatever units the data is AFTER the resolution and offset is applied to the CAN Receive signal.

6.10. Control States

The **Battery Charger State** control source will output the current mode that the charging algorithm is using.

Value	Charger Mode
0	Idle Mode
1	Precharge Mode
2	Bulk Charge Mode
3	Constant Voltage Mode
4	Equalize Mode
5	Float Mode
6	Standby Mode
7	Battery Error Mode
8	Module Error Mode
9	Detect Battery Mode

Table 14 – Battery Charger States

The **Power Line State** control source will output the presence of a power source for the controller, independent of the battery.

Value	Charger Mode
0	Power Off
1	Power On

Table 15 – Power Line States

The **Battery State** control source will output the presence of a battery, independent of the power source.

Value	Charger Mode
0	No Battery
1	Battery Present

Table 16 – Battery States

The **Temperature State** control source will output the state of the temperature measured by the controller.

Value	Charger Mode
0	Temperature Above Normal
1	Temperature Normal

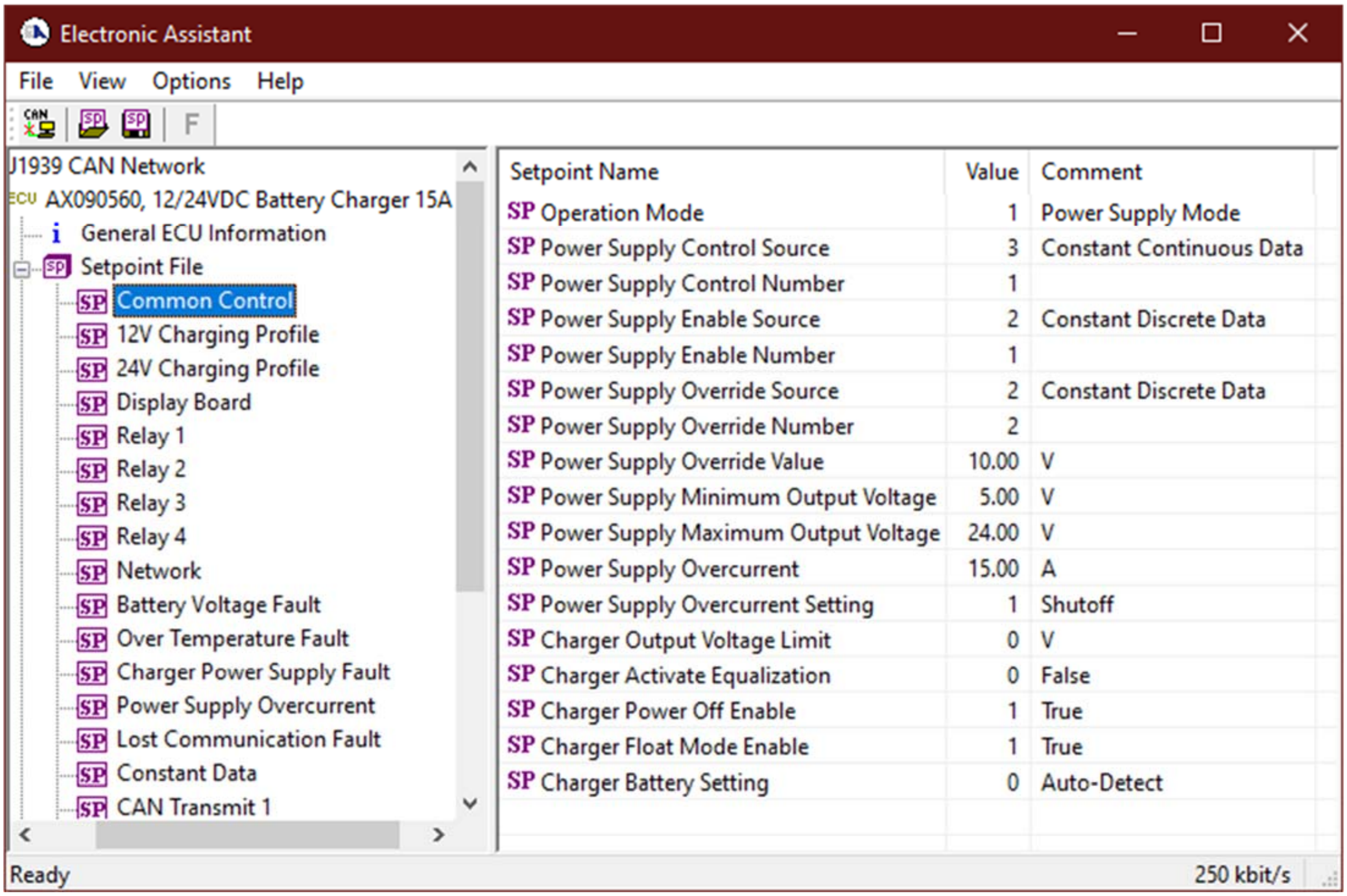
Table 17 – Temperature States

7. ECU SETPOINTS ACCESSED WITH ELECTRONIC ASSISTANT

Many setpoints have been referenced throughout this manual. This section describes in detail each setpoint, their defaults and ranges. For more information on how each setpoint is used, refer to the relevant section of the user manual.

7.1. Common Control Setpoints

The Common Control function block is defined in Section 6.1, with the setpoints pertaining to power supply operation being detailed in Section 3. Please refer there for detailed information about how all these setpoints are used.



Screen Capture of Common Control Setpoints

Name	Range	Default Value
Operation Mode	Drop List	0; Battery Charger
Power Supply Control Source	Drop List	0; Control Not Used
Power Supply Control Number	1 … 4	1
Power Supply Enable Source	Drop List	0; Control Not Used
Power Supply Enable Number	1 … 4	1
Power Supply Override Source	Drop List	0; Control Not Used
Power Supply Override Number	1 … 4	1
Power Supply Minimum Output Voltage	5 … MaxVoltage	5V
Power Supply Maximum Output Voltage	MinVoltage … 26	24V

Power Supply Overcurrent	0 … 15	15A
Power Supply Overcurrent Setting	Drop List	1; Shutoff
Charger Output Voltage Limit	False/True	0; False
Charger Activate Equalize Mode	False/True	0; False
Charger Power-Off Enable	False/True	1; True

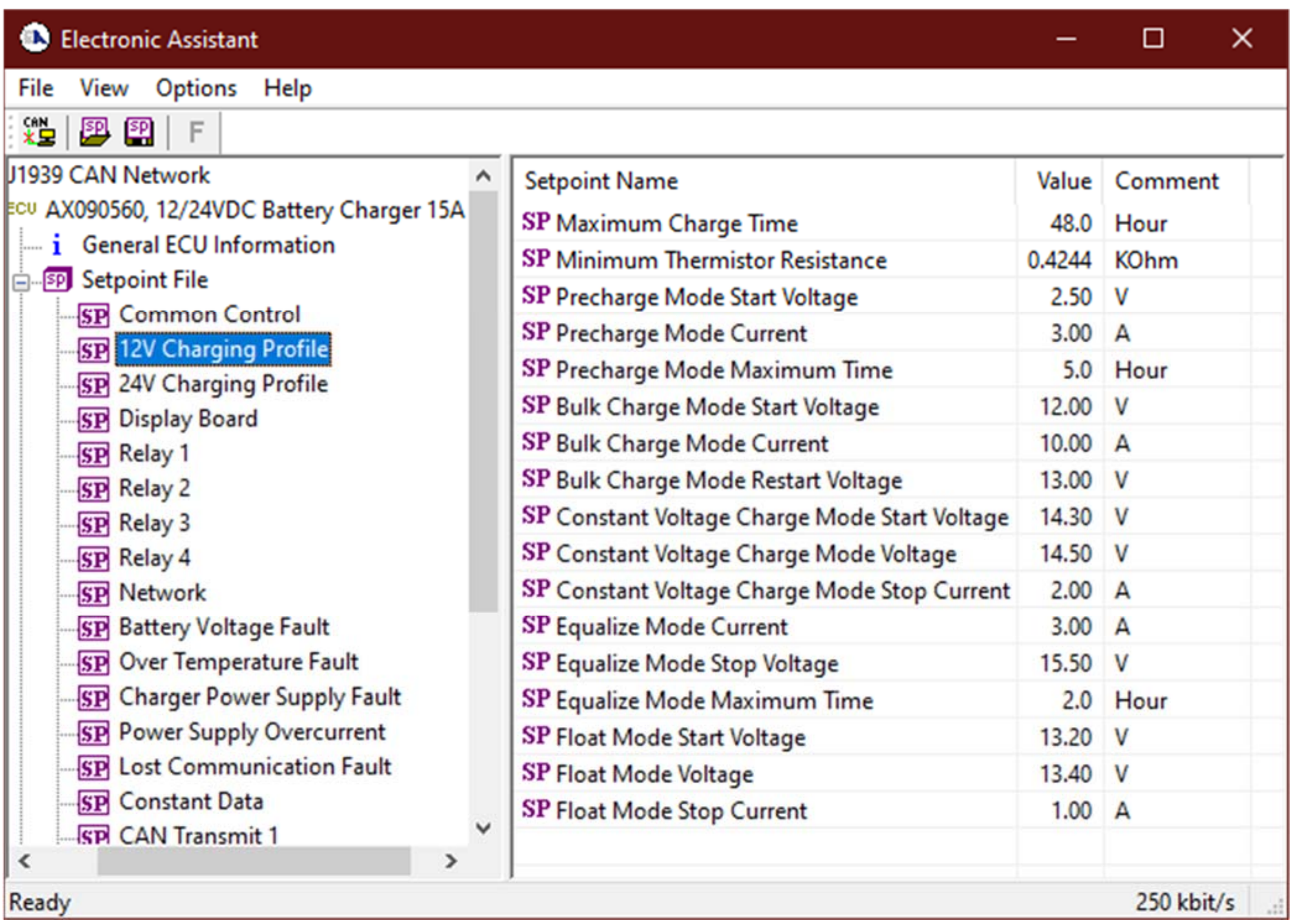
Table 18 – Default Common Control Setpoints

The AX090560 model includes additional setpoints; the Float Mode Enable setpoint is moved from the charging profile, and the Battery Setting setpoint is used to either lock the charging profile or let it be determined by auto-detection.

Charger Float Mode Enable	False/True	0; False
Charger Battery Setting	Auto-Detect, Lock 12V Battery, Lock 24V Battery	0; Auto-Detect

7.2. Charging Profile Setpoints

The Charging Profile function block is defined in Section 2. Please refer to that section for detailed information on how these setpoints are used. The AX090560 model has two charging profiles, for 12V and 24V batteries respectively. The Float Mode Enable setpoint is moved to the previous setpoint group for AX090560 units.



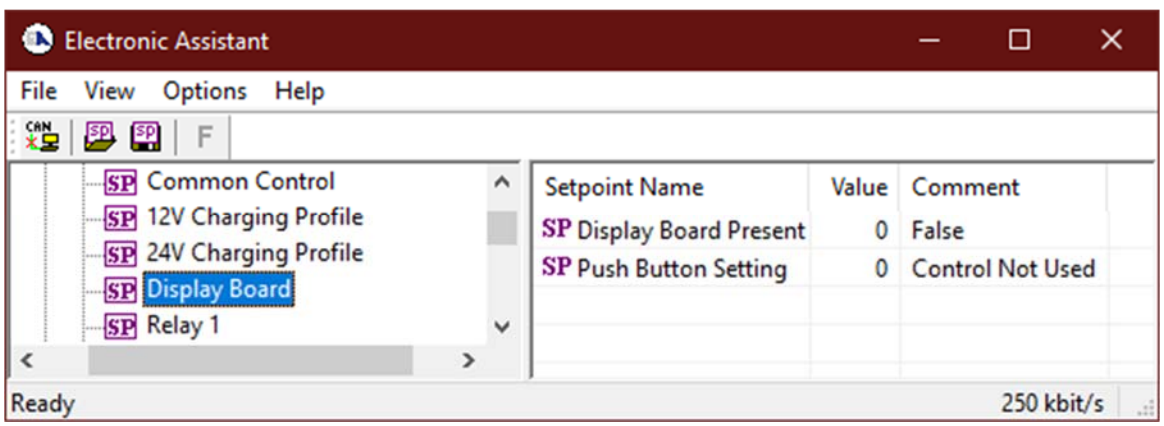
Screen Capture of Default Charging Profile Setpoints

Name	Range	12V Profile Default Value	24V Profile Default Value
Maximum Charge Time	0.1…500	48	48
Minimum Temp. Monitor Resistance	0.1…30.0	0.4244	0.4244
Precharge Mode Start Voltage	2.5…30.0	2.5	5.0
Precharge Mode Current	0.5…10.0	3.0	3.0
Precharge Mode Maximum Time	0.1…500.0	5.0	5.0
Bulk Charge Mode Start Voltage	2.5…30.0	12.0	20.0
Bulk Charge Mode Current	0.5…10.0	10.0	15.0
Bulk Charge Mode Restart Voltage	2.5…30.0	13.0	26.0
Constant Voltage Charge Mode Start Voltage	2.5…30.0	14.3	27.5
Constant Voltage Charge Mode Voltage	2.5…30.0	14.5	28.0
Constant Voltage Charge Mode Stop Current	0.5…10.0	2.0	4.0
Equalize Mode Current	0.5…10.0	3.0	6.0
Equalize Mode Stop Voltage	2.5…30.0	15.5	30.0
Equalize Mode Maximum Time	0.1…500.0	2.0	2.0
Float Mode Enable	False/True	1; True	1; True
Float Mode Start Voltage	2.5…30.0	13.2	26.4
Float Mode Voltage	2.5…30.0	13.4	26.8
Float Mode Stop Current	0.5...10.0	1.0	2.0

Table 19 – Default Charging Profile Setpoints

7.3. Display Board Setpoints

The Display Board function block is defined in Section 6.3. Please refer there for detailed information about how all these setpoints are used.



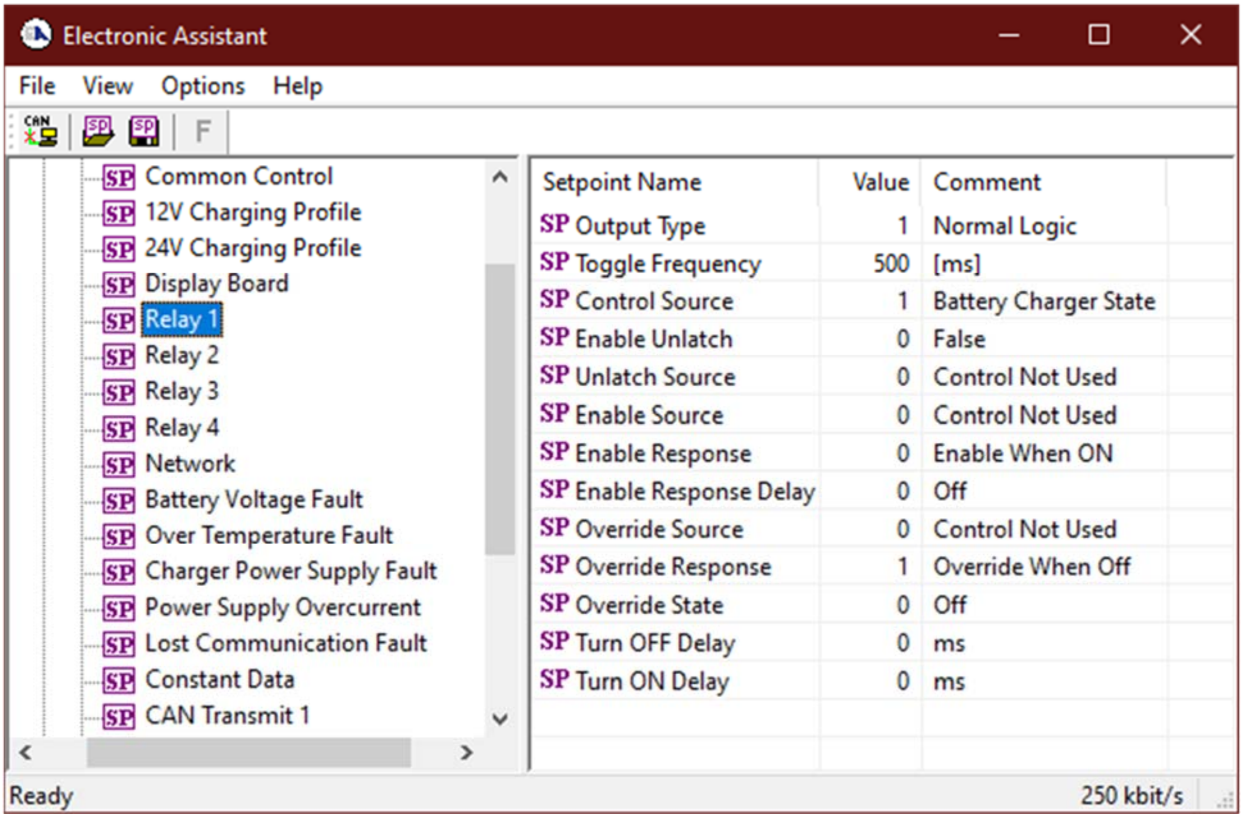
Screen Capture of Display Board Setpoints

Name	Range	Default Value
Display Board Present	False/True	0; False
Push Button Setting	Drop List	0; Control Not Used

Table 20 – Default Display Board Setpoints

7.4. Relay Output Setpoints

The Relay Output function block is defined in Section 6.4. Please refer there for detailed information about how all these setpoints are used.



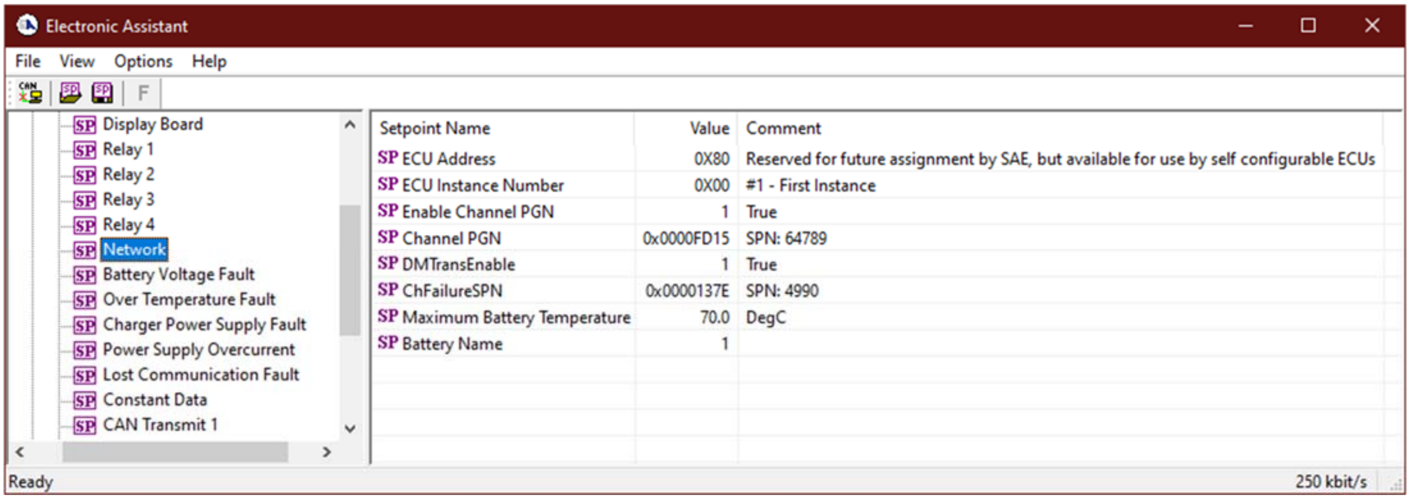
Screen Capture of Default Relay Output Setpoints

Name	Range	Default Value
Output Type	Drop List	1; Normal Logic
Toggle Frequency	0…60000	500
Control Source	Drop List	Differs on relay number
Unlatch Source	Drop List	0; No Source
Enable Source	Drop List	0; No Source
Enable Response	Drop List	0; Enable When On
Enable Response Delay	Off/On	0; Off
Override Source	Drop List	0; No Source
Override Response	Drop List	0; Override When On
Override State	Off/On	0; Override State Off
Turn OFF Delay	0…86400000	0
Turn ON Delay	0…86400000	0

Table 21 – Default Relay Output Setpoints

7.5. Network Setpoints

The Network function block is defined in Section 5 and Section 6.5. Please refer there for detailed information about how all these setpoints are used.



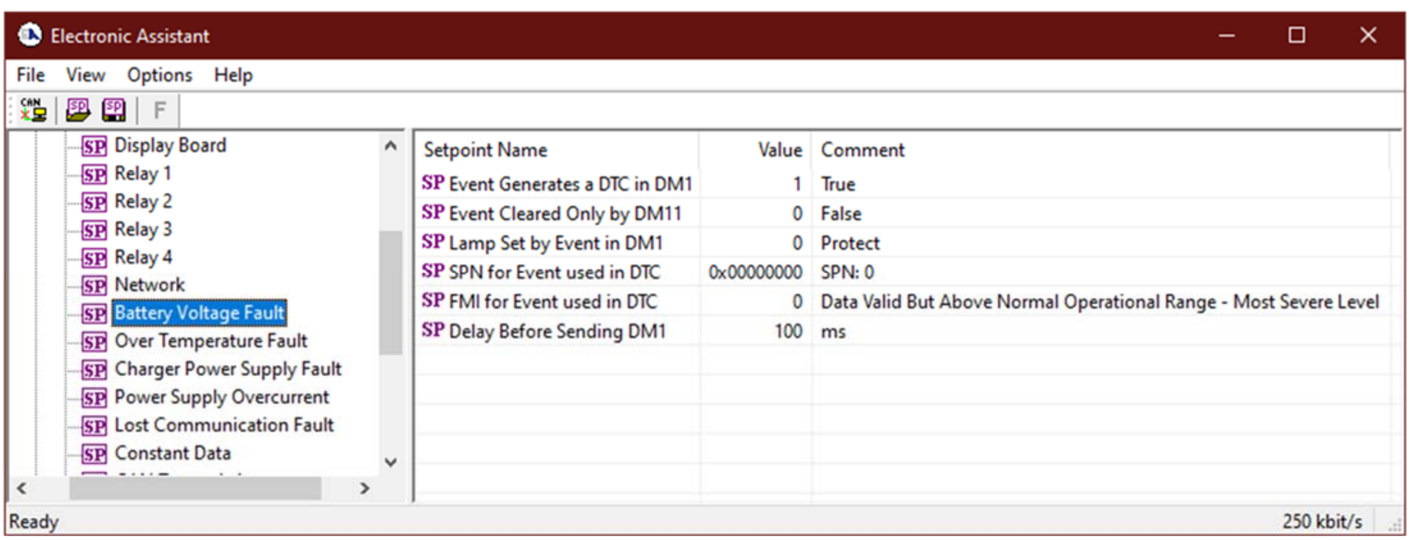
Screen Capture of Default Network Setpoints

Name	Range	Default Value
ECU Address	0…253	128
ECU Instance	0…6	0; 1st Instance
Enable Channel PGN	False/True	1; True
Channel PGN	0x0…0x7FFFF	64789
DM Trans Enable	False/True	1; True
Channel Failure SPN	0x0…0x7FFFF	4990
Maximum Battery Temperature	-40.0…210.0 °C	70.0
Battery Name	Drop List	0

Table 22 – Default Network Setpoints

7.6. Diagnostic Input Setpoints

The Diagnostic Input function block is defined in Section 6.6. Please refer to that section for detailed information about how all these setpoints are used.



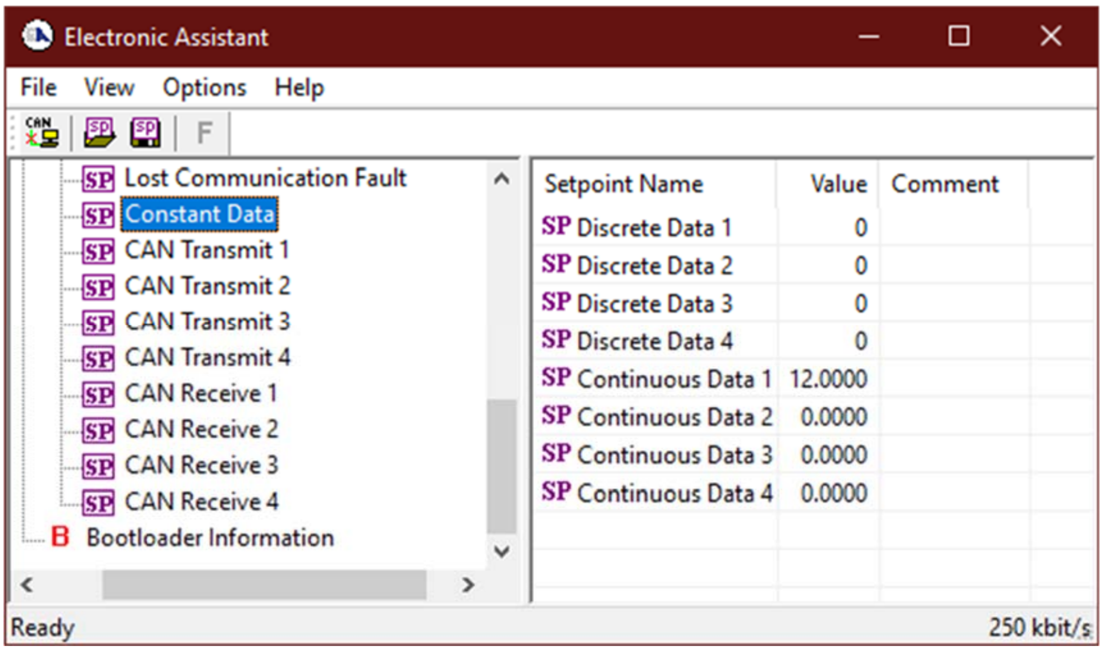
Screen Capture of Diagnostic Input Setpoints

Name	Range	Default
Event Generates a DTC in DM1	False/True	1; True
Event Only Cleared by DM11	False/True	0; False
Lamp Set by Event in DM1	Drop List	0
SPN for Event used in DTC	0…524287	0
FMI for Event used in DTC	Drop List	0
Delay Before Sending DM1	0…60000	100

Table 23 – Default Diagnostic Input Setpoints

7.7. Constant Data

The Constant Data function block is defined in Section 6.7. Please refer to that section for detailed information about how all these setpoints are used.



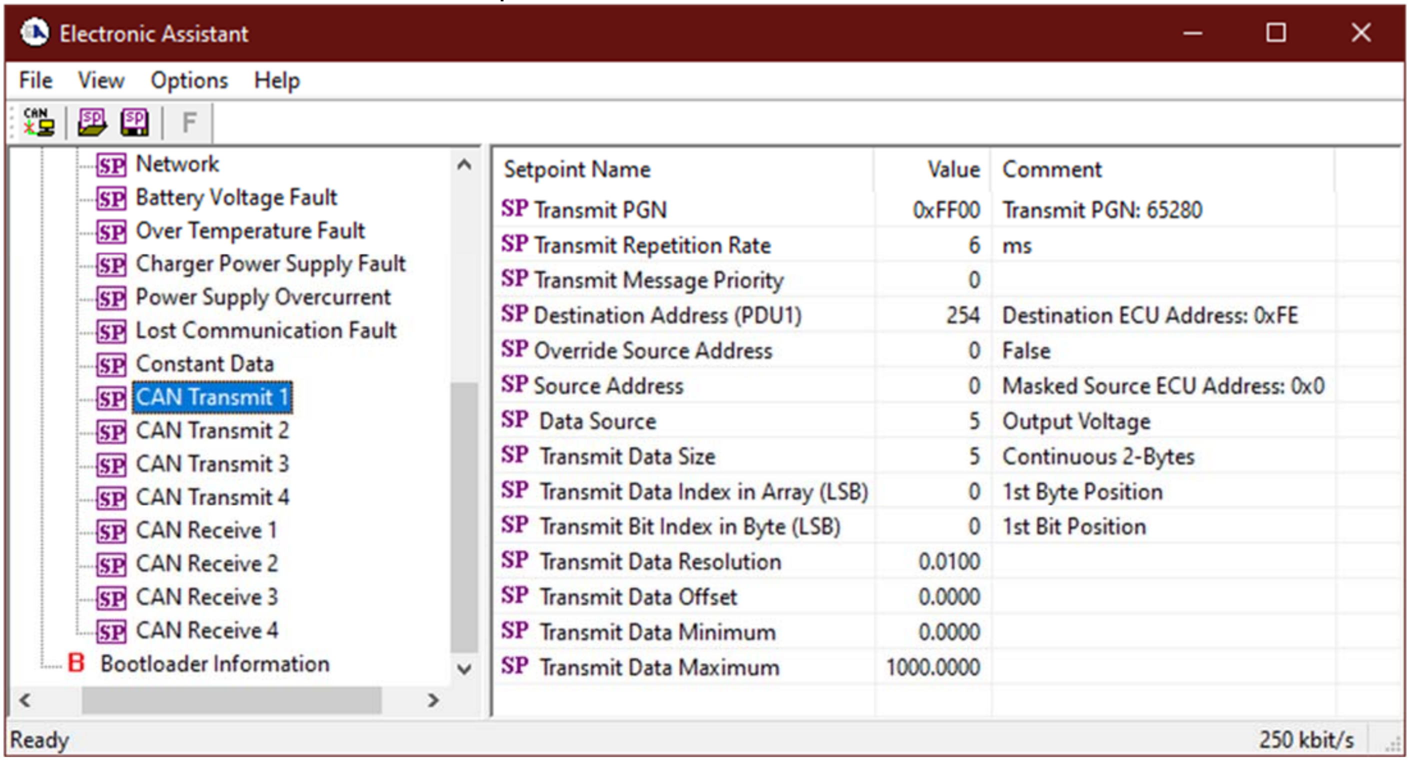
Screen Capture of Constant Data Setpoints

Name	Range	Default
Discrete Data 1	0 … 4294967295	0
Discrete Data 2	0 … 4294967295	0
Discrete Data 3	0 … 4294967295	0
Discrete Data 4	0 … 4294967295	0
Continuous Data 1	-0xFFFFFFFF … 0xFFFFFFFF	0
Continuous Data 2	-0xFFFFFFFF … 0xFFFFFFFF	0
Continuous Data 3	-0xFFFFFFFF … 0xFFFFFFFF	0
Continuous Data 4	-0xFFFFFFFF … 0xFFFFFFFF	0

Table 24 – Default Constant Data Setpoints

7.8. CAN Transmit Setpoints

The CAN Transmit function block is defined in Section 6.8. Please refer to that section for detailed information about how all these setpoints are used.



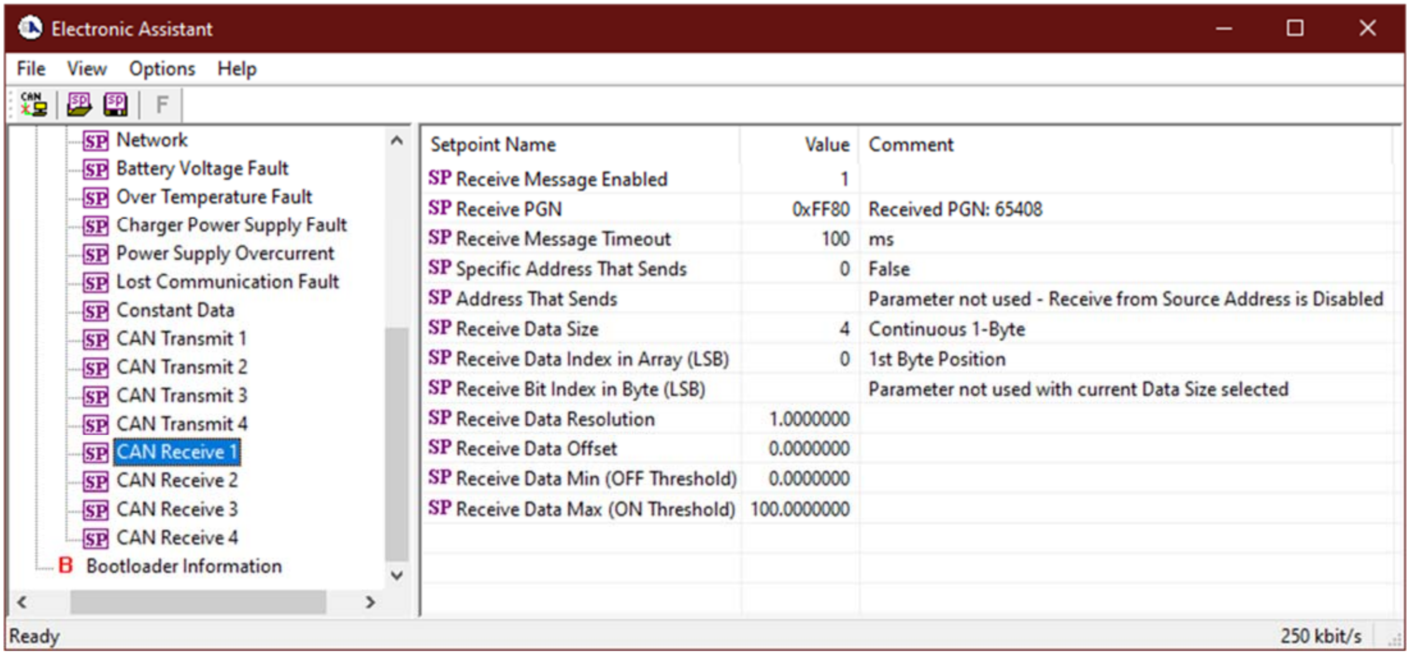
Screen Capture of CAN Transmit Setpoints

Name	Range	Default
Transmit PGN	0…65535	65280 ($FF00)
Transmit Repetition Rate	0…60,000	50
Transmit Message Priority	0…7	6
Destination Address (PDU1)	0…255	254
Override Source Address	False/True	0; False
Source Address	0…255	0
Signal x Data Source	Drop List	Depends on signal number
Signal x Transmit Data Size	Drop List	Depends on signal number
Signal x Transmit Data Index in Array (LSB)	0 to 8-DataSize	Depends on signal number
Signal x Transmit Bit Index in Byte (LSB)	0 to 8-DataSize	Depends on signal number
Signal x Transmit Data Resolution	-10^6 to 10^6	1.0
Signal x Transmit Data Offset	-10^4 to 10^4	0
Signal x Transmit Data Minimum	-0xFFFFFFFF…DataMax	0
Signal x Transmit Data Maximum	DataMin…0xFFFFFFFF	Depends on signal number

Table 25 – Default CAN Transmit Setpoints

7.9. CAN Receive Setpoints

The CAN Receive function block is defined in Section 6.9. Please refer to that section for detailed information about how all these setpoints are used.



Screen Capture of CAN Receive Setpoints

Name	Range	Default
Receive Message Enable	False/True	True
Receive PGN	0…65535	65408 ($FF80)
Receive Message Timeout	0…60000	100
Specific Address That Sends	False/True	True
Address That Sends	0…255	254 ($FE)
Receive Data Size	Drop List	Continuous 1-Byte
Receive Data Index in Array (LSB)	0…8-DataSize	Byte 1
Receive Bit Index in Byte (LSB)	0…8-DataSize	0
Receive Data Resolution	-10^6 to 10^6	1
Receive Data Offset	-10^4 to 10^4	0
Receive Data Minimum	-0xFFFFFFFF…DataMax	0
Receive Data Maximum	DataMin…0xFFFFFFFF	0

Table 26 – Default CAN Receive Setpoints

8. BATTERY CHARGER ERROR CODES

If the charging process fails, the battery charger will switch to either Battery Error or Module Error Mode, and an error code specifying the error will be generated.

The error code can be viewed through the RS232 interface selecting the Internal State of the Controller main menu item.

8.1. Battery Error Codes

Error Code Name	Error Code Value
NO_ERROR	0
LOW_VOLTAGE_TO_START_PRECHARGE_BATTERY_ERROR	1
OVERTEMPERATURE_IN_PRECHARGE_MODE_BATTERY_ERROR	2
UNABLE_TO_MAINTAIN_CURRENT_IN_PRECHARGE_MODE_BATTERY_ERROR	3
PRECHARGE_TIME_OUT_BATTERY_ERROR	4
CHARGE_TIME_OUT_BATTERY_ERROR	5
OVERTEMPERATURE_IN_CHARGE_MODE_BATTERY_ERROR	6
UNABLE_TO_MAINTAIN_CURRENT_IN_CHARGE_MODE_BATTERY_ERROR	7
OVERTEMPERATURE_IN_CONST_VOLTAGE_MODE_BATTERY_ERROR	8
OVERTEMPERATURE_IN_EQUALIZE_MODE_BATTERY_ERROR	9
UNABLE_TO_MAINTAIN_CURRENT_IN_EQUALIZE_MODE_BATTERY_ERROR	10
OVERTEMPERATURE_IN_FLOAT_MODE_BATTERY_ERROR	11

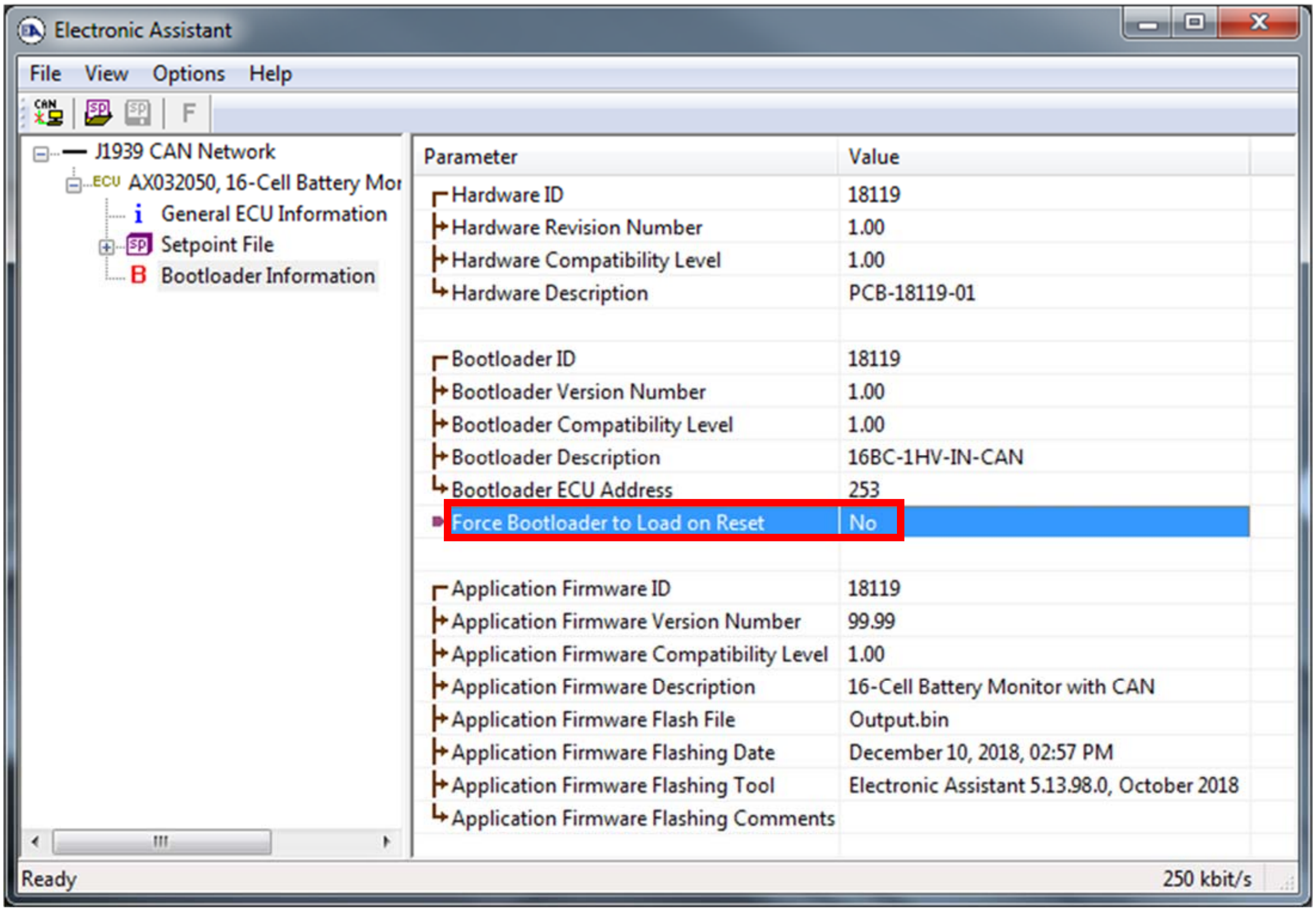
8.2. Module Error Codes

Error Code Name	Error Code Value
OVERVOLTAGE_IN_PRECHARGE_MODE_MODULE_ERROR	100
OVERCURRENT_IN_PRECHARGE_MODE_MODULE_ERROR	101
LOW_POWER_IN_PRECHARGE_MODE_MODULE_ERROR	102
OVERVOLTAGE_IN_CHARGE_MODE_MODULE_ERROR	103
OVERCURRENT_IN_CHARGE_MODE_MODULE_ERROR	104
LOW_POWER_IN_CHARGE_MODE_MODULE_ERROR	105
OVERVOLTAGE_IN_CONST_VOLTAGE_MODE_MODULE_ERROR	106
OVERCURRENT_IN_CONST_VOLTAGE_MODE_MODULE_ERROR	107
LOW_POWER_IN_CONST_VOLTAGE_MODE_MODULE_ERROR	108
OVERVOLTAGE_IN_EQUALIZE_MODE_MODULE_ERROR	109
OVERCURRENT_IN_EQUALIZE_MODE_MODULE_ERROR	110
LOW_POWER_IN_EQUALIZE_MODE_MODULE_ERROR	111
OVERVOLTAGE_IN_FLOAT_MODE_MODULE_ERROR	112
OVERCURRENT_IN_FLOAT_MODE_MODULE_ERROR	113
LOW_POWER_IN_FLOAT_MODE_MODULE_ERROR	114
FLASH_MEMORY_MODULE_ERROR	1000

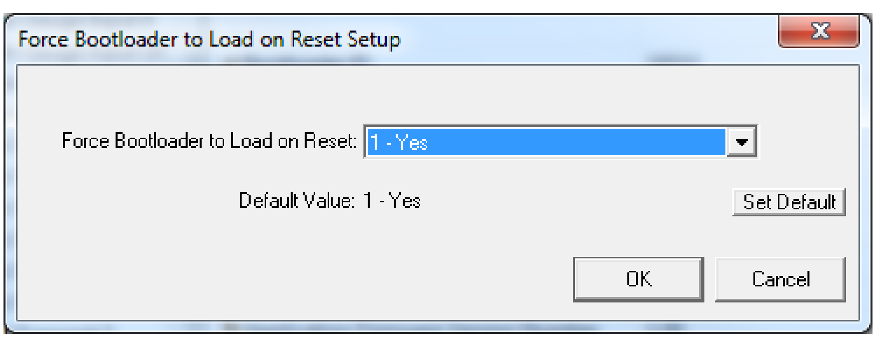
9. REFLASHING OVER CAN WITH EA BOOTLOADER

The AX090550 or AX090560 unit can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

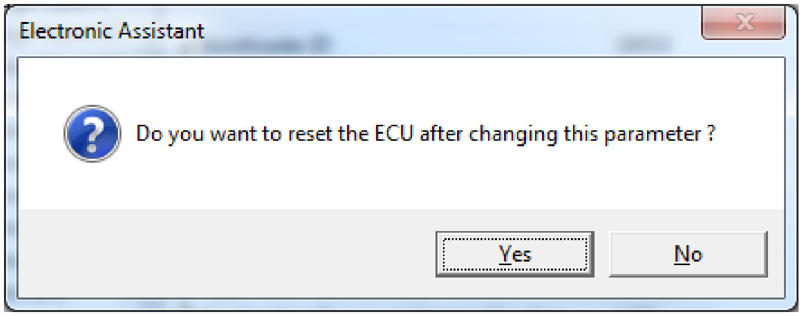
1. When EA first connects to the ECU, the **Bootloader Information** section will display the following information.



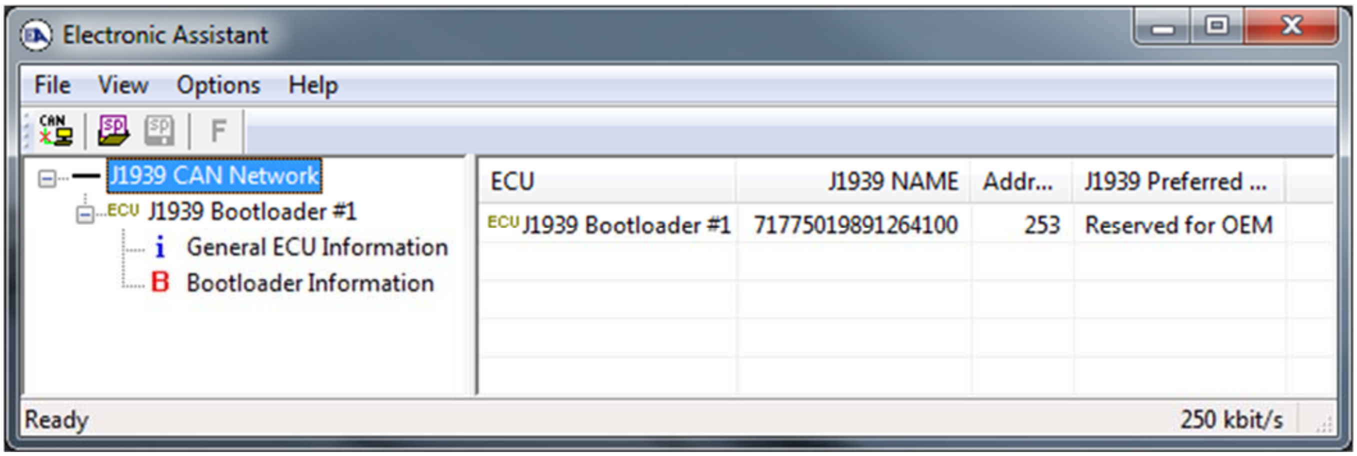
2. To use the bootloader to upgrade the firmware running on the ECU, change the variable **"Force Bootloader to Load on Reset**" to *Yes*.

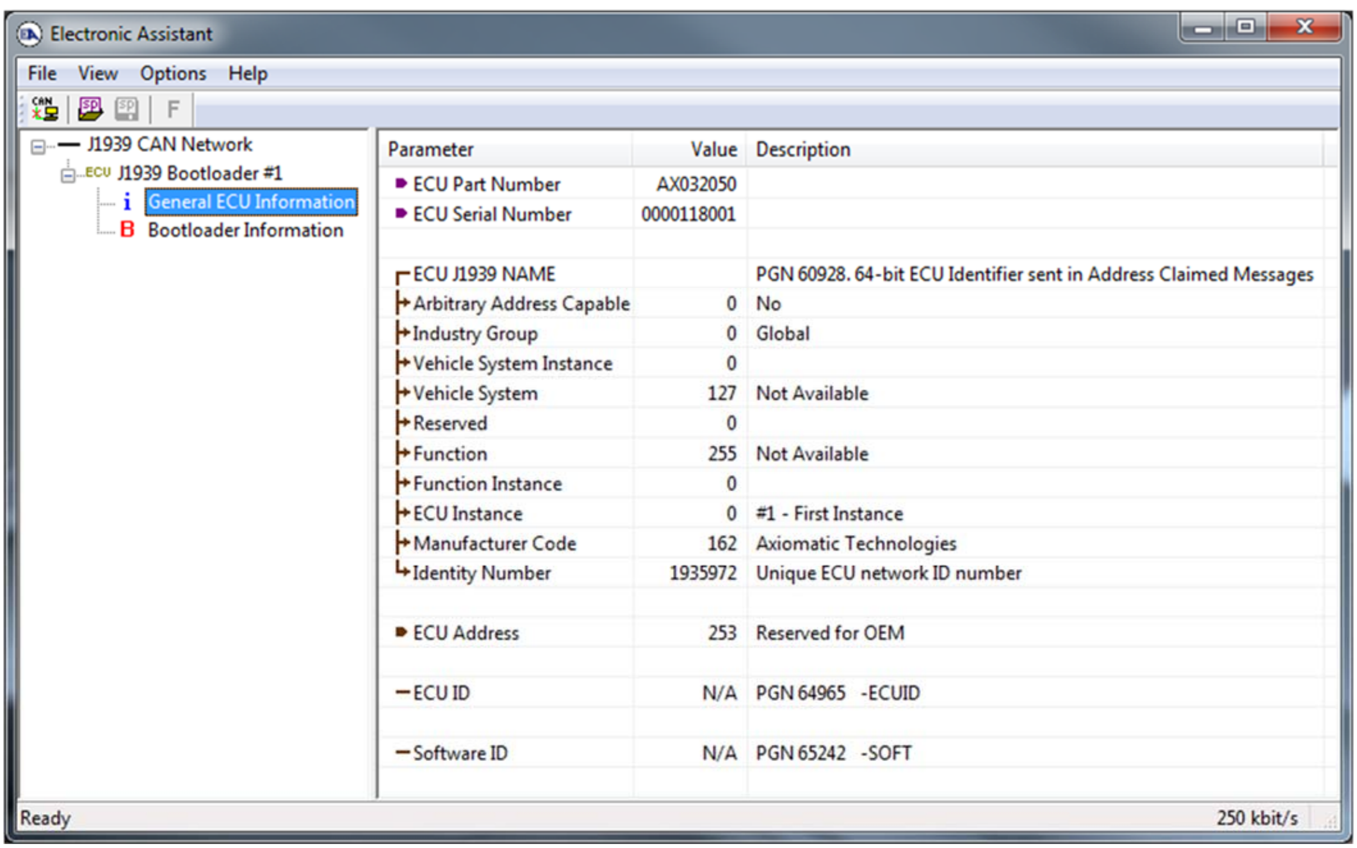


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



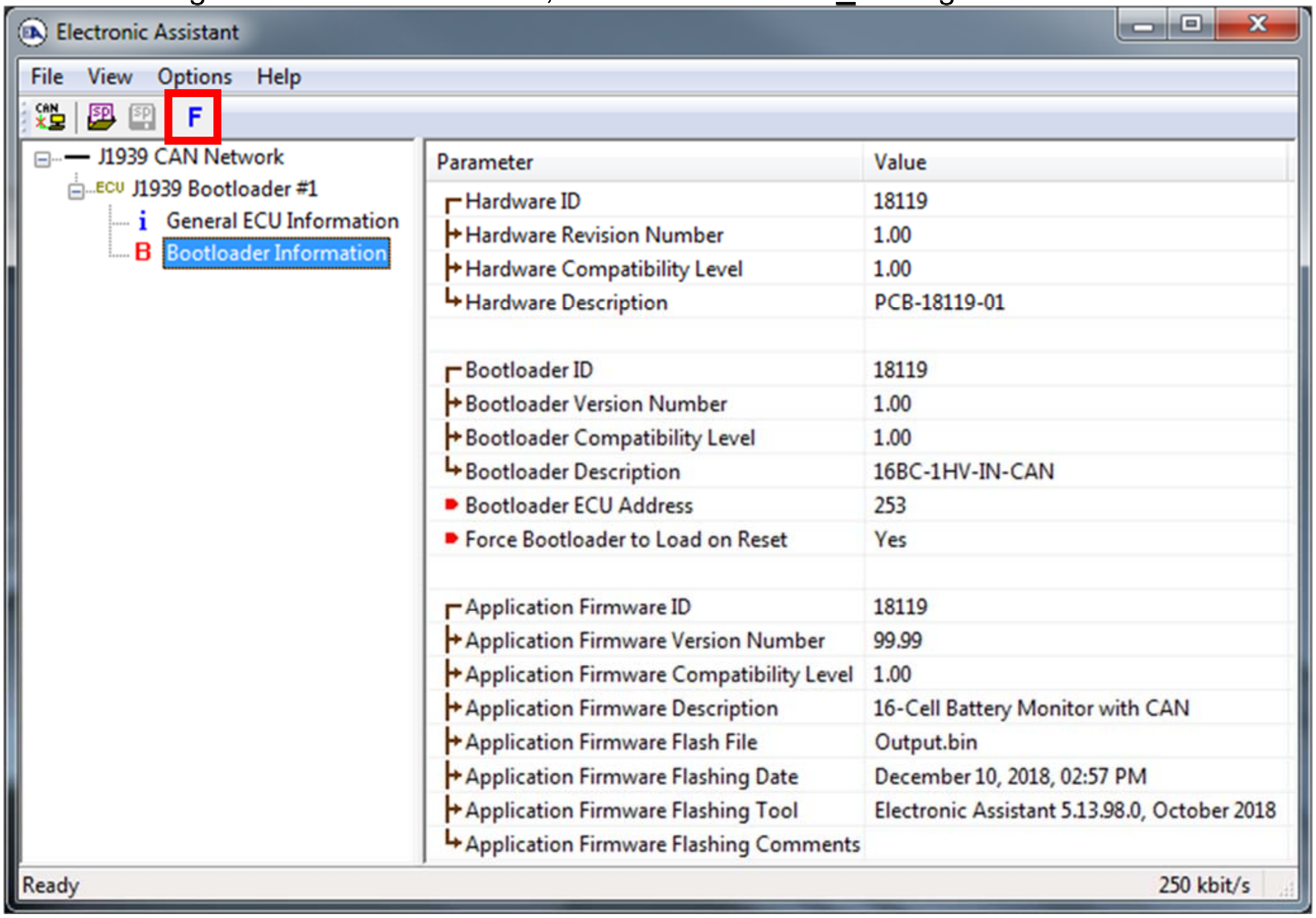
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX0905x0 but rather as **J1939 Bootloader #1**.





Note that the bootloader is NOT Arbitrary Address Capable. This means that if you want to have multiple bootloaders running simultaneously (not recommended) you would have to manually change the address for each one before activating the next, or there will be address conflicts, and only one ECU would show up as the bootloader. Once the 'active' bootloader returns to regular functionality, the other ECU(s) would have to be power cycled to re-activate the bootloader feature.

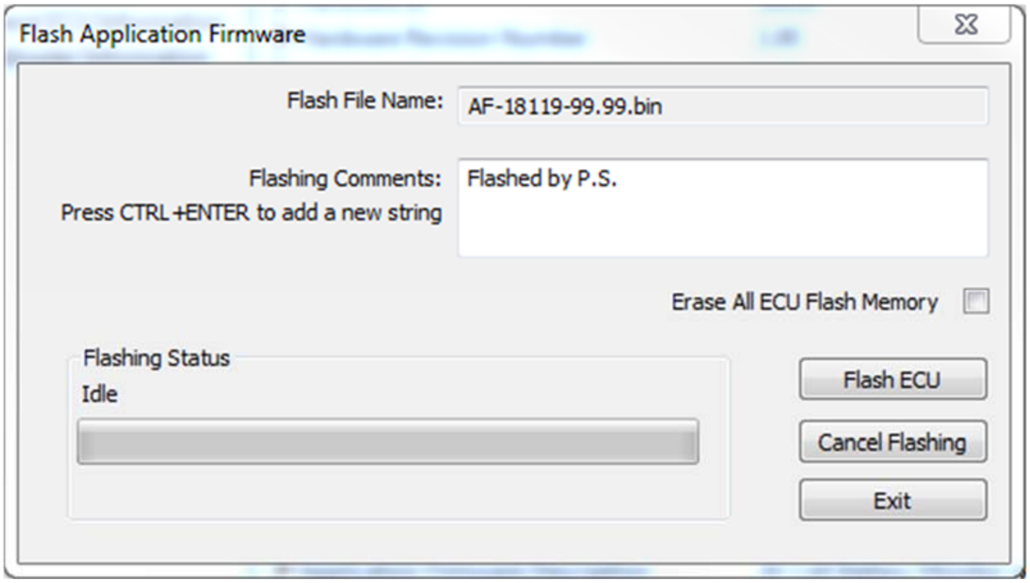
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX0905x0 firmware, but in this case the Flashing feature has been enabled.



6. Select the Flashing button and navigate to where you had saved the **AF-18123-x.yy.bin** or **AF-19146-x.yy.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the EA tool)

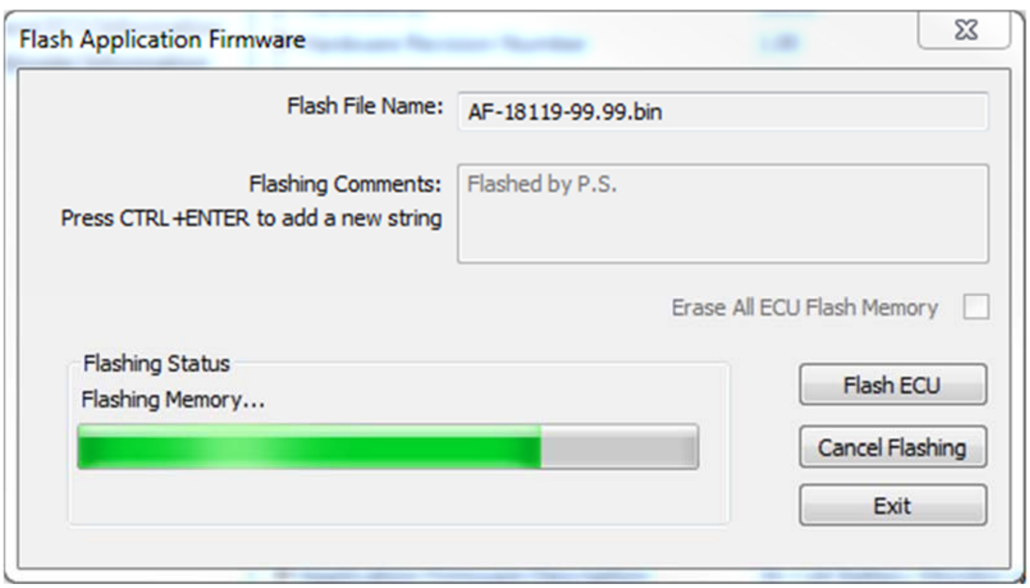
7. Once the Flash Application Firmware window opens, you can enter comments such as "Firmware upgraded by [Name]" if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

   Note: You do not have to date/timestamp the file, as this is done automatically by the EA tool when you upload the new firmware.

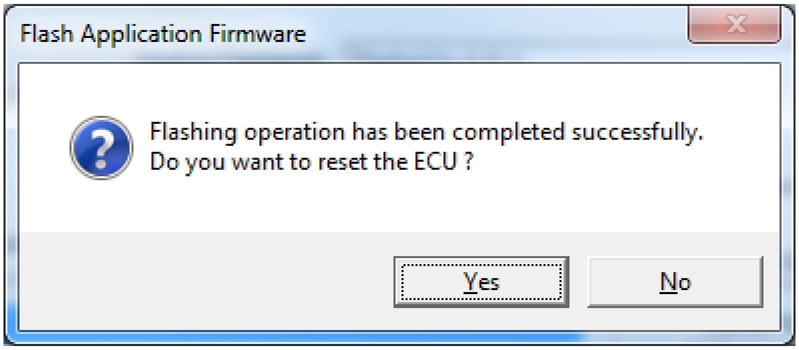


WARNING: Do not check the "Erase All ECU Flash Memory" box unless instructed to do so by your Axiomatic contact. Selecting this will erase ALL data stored in non-volatile flash. It will also erase any configuration of the setpoints that might have been done to the ECU and reset all setpoints to their factory defaults. By leaving this box unchecked, none of the setpoints will be changed when the new firmware is uploaded.

8. A progress bar will show how much of the firmware has been sent as the upload progresses. The more traffic there is on the J1939 network, the longer the upload process will take.

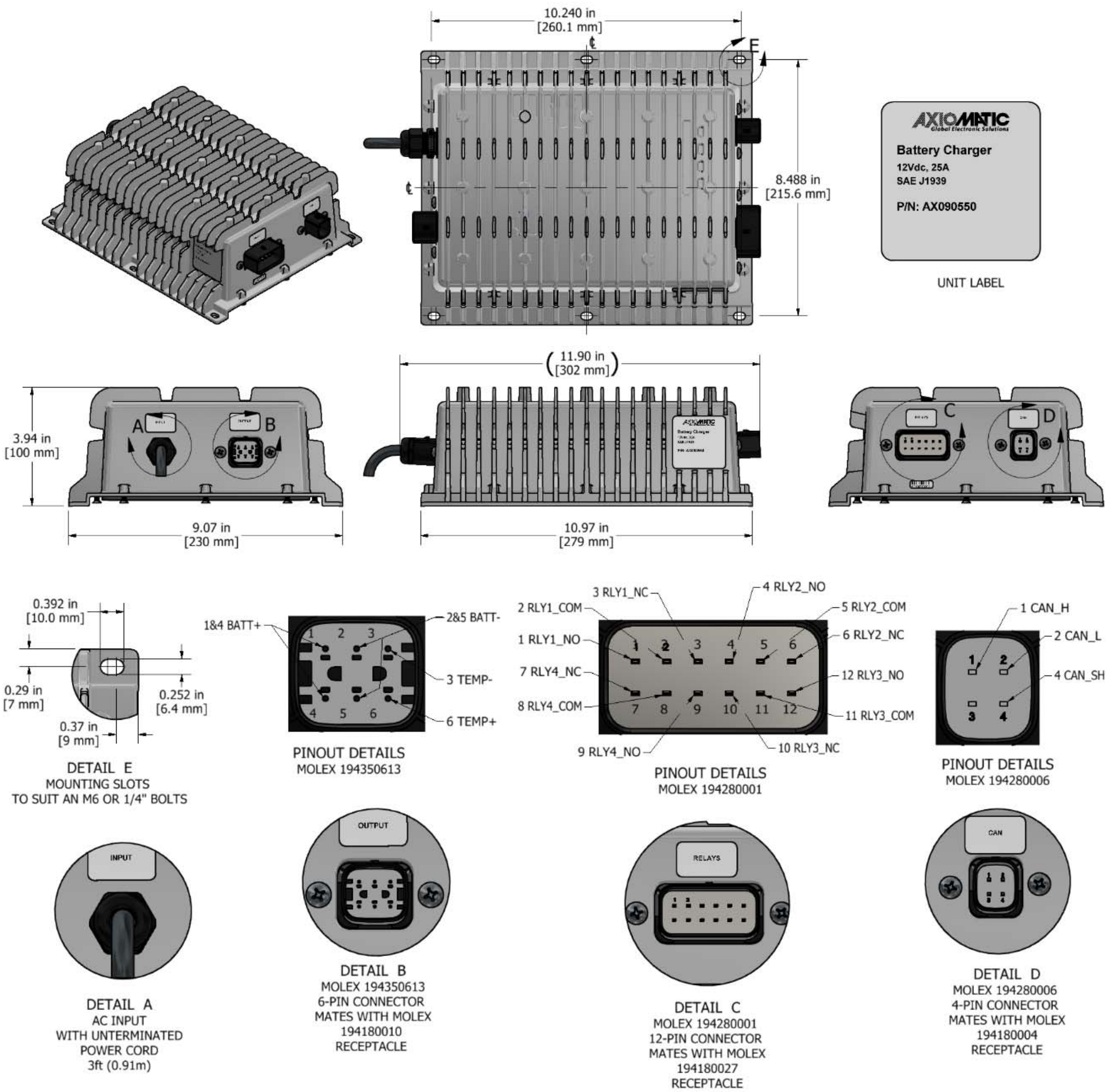


9. Once the firmware has finished uploading, a message will popup indicating the successful operation. If you select to reset the ECU, the new version of the AX0905x0 application will start running, and the ECU will be identified as such by EA. Otherwise, the next time the ECU is power-cycled, the AX0905x0 application will run rather than the bootloader function.



Note: If at any time during the upload the process is interrupted, the data is corrupted (bad checksum) or for any other reason the new firmware is not correct, i.e. bootloader detects that the file loaded was not designed to run on the hardware platform, the bad or corrupted application will not run. Rather, when the ECU is reset or power-cycled the **J1939 Bootloader** will continue to be the default application until valid firmware has been successfully uploaded into the unit.

10. INSTALLATION INSTRUCTIONS



Models AX090550 and AX090560 have identical dimensions and pinouts.

<table>
<tr>
<td>Electrical Connections</td>
<td>
1 4-pin Molex 194280006 (Mates with Molex 194180004 Receptacle)
CAN Connector:
<table>
<tr><td>PIN#</td><td>Function</td></tr>
<tr><td>1</td><td>CAN_H</td></tr>
<tr><td>2</td><td>CAN_L</td></tr>
<tr><td>3</td><td>Not Used</td></tr>
<tr><td>4</td><td>CAN_SH</td></tr>
</table>

1 12-pin Molex 194280001 (Mates with Molex 194180027 Receptacle)
Relay Outputs Connector:
<table>
<tr><td>PIN#</td><td>Function</td></tr>
<tr><td>1</td><td>Relay 1 NO</td></tr>
<tr><td>2</td><td>Relay 1 COM</td></tr>
<tr><td>3</td><td>Relay 1 NC</td></tr>
</table>
</td>
</tr>
</table>

	4 Relay 2 NO 5 Relay 2 COM 6 Relay 2 NC 7 Relay 4 NO 8 Relay 4 COM 9 Relay 4 NC 10 Relay 3 NC 11 Relay 3 COM 12 Relay 3 NO 1 6-pin Molex 1943506011 (Mates with Molex 194180010 Receptacle) **Battery Connector**: PIN# Function 1 Output to Battery + 2 Output to Battery - 3 Battery Temperature - 4 Output to Battery + 5 Output to Battery - 6 Battery Temperature +
Power Connection	Power Cable: Heyco 3213 sealed cable gland Integral 3 ft. (0.9 m) **unterminated power cable**. The power plug is not supplied. Black Wire: Live White Wire: Neutral Green Wire: Ground
Mating Connectors	Mating plug kits can be ordered from Axiomatic.
Mounting	Use 6 M8 or 5/16 inch bolts to mount the device.

11. TECHNICAL SPECIFICATIONS

11.1. Input Specifications

Power Supply Input - Nominal	120 VAC, 208VAC or 240VAC nominal 95 to 260 VAC, 45/65 Hz power supply range (60 Hz units and 50/60 Hz units) Power factor correction >0.99 Two internal fuses L and N, 8A, 250VAC
Surge Protection	Provided
Under-voltage Protection	Provided
Over-voltage Protection	Provided
Digital Input	1 digital input 5V TTL 10K Pull up Active Low
Digital Ground	Provided

11.2. Output Specifications

Output to Battery	User configurable for 12 or 24VDC Maximum output is 450 Watts @ 24Vdc or 225 Watts @ 15Vdc.
Protection Against Reverse Battery Connection	Provided
Over-voltage Protection	Provided
Output Voltage and Current (nominal depending on settings)	User configurable Voltage: 2.5 – 30 VDC depending on the charging mode and user configuration. Current: 0.5 – 15 ADC depending on the charging mode and user configuration.
Thermal Protection	A connection point is provided for an external NTC thermistor (not supplied) to protect the battery. The input is 5V via a 1K00 Ohm pull-up resistor inside the charger.
Relay Outputs	4 independent alarms for AC fail, charger fail, low battery volts, high battery volts to meet NFPA 110 requirements or for other functions Dry contacts (FORM C) Rating of relays: 2A max @ 30Vdc (resistive load), UL Class 2

11.3. General Specifications

Microprocessor	STM32F205VGT7
Control Logic	Standard embedded software Battery charger setpoints can be viewed and configured through the CAN bus using the Axiomatic Electronic Assistant (EA).
Recommended Battery Type	Generic automotive 12V rechargeable lead acid batteries Other battery chemistries are available.
Recommended Battery Capacity	Up to 100 Ah

Efficiency	90% @ max. load and 240VAC 87% @ max. load and 120VAC
Diagnostics	The charger's dynamic parameters, voltage and current are broadcast over the J1939 network.
User Interface	Electronic Assistant p/n: AX070502, for *Windows* operating systems It comes with a royalty-free license for use on multiple computers.
CAN Interface	1 CAN port (ISO 11898 compatible) Termination resistor is not installed. SAE J1939 stack; Baud Rate: 250 bit/sec.
Optional Communication Interfaces	The following converters can be installed to interface with industrial fieldbus communications or wireless communications. CAN/Bluetooth Converter: AX141100 CAN/CAN/Modbus RTU Converter: AX140100 CAN/Ethernet Converter: AX140900
Fusing	An external output fuse of 15 Amps is recommended.
Operating Temperature (ambient)	-40 to 70°C (-40 to 158°F) for input >170 VAC, -40 to 60°C (-40 to 140°F) for input 90 to 170 VAC
Storage Temperature	-40 to 105°C (-40 to 221°F)
Protection Rating	OEM model: IP67
Approvals	PENDING CE marking, FCC, UL recognition
Vibration	PENDING MIL-STD-202G, Test 204D and 214A (Sine and Random) 10 g peak (Sine); 7.86 Grms peak (Random)
Shock	PENDING MIL-STD-202G, Test 213B; 50 g
Enclosure and Dimensions- Battery Charger	ACD12 Die Cast Aluminum Enclosure and Lid, Hard Anodized to MIL-A-8625 Type II Class I Clear Hard Anodize Molded EPDM Gasket Molex Connectors (See electrical connections.) 11.83 x 8.74 x 3.88 inches (300 x 222 x 98 mm) L x W x H excluding power cable assembly Refer to the dimensional drawing, Figure 1.0.
Weight	5312 grams (preliminary)

12. VERSION HISTORY

Version	Date	Author	Modifications
1	January 8, 2020	Peter Sotirakos	Initial Draft; Modified UMAX090550 V1 User Manual to include AX090560 information
1.1	March 9, 2020	Peter Sotirakos	Dimensional Drawing and corresponding references updated.
1.2	June 3, 2020	Peter Sotirakos	Dimensional Drawing and corresponding references updated.
1.3	August 4, 2020	Peter Sotirakos	LED Indicator section removed. Battery Charger State table added.
2.0	November 24, 2020	Peter Sotirakos	Updated for firmware version V2.00